(11)

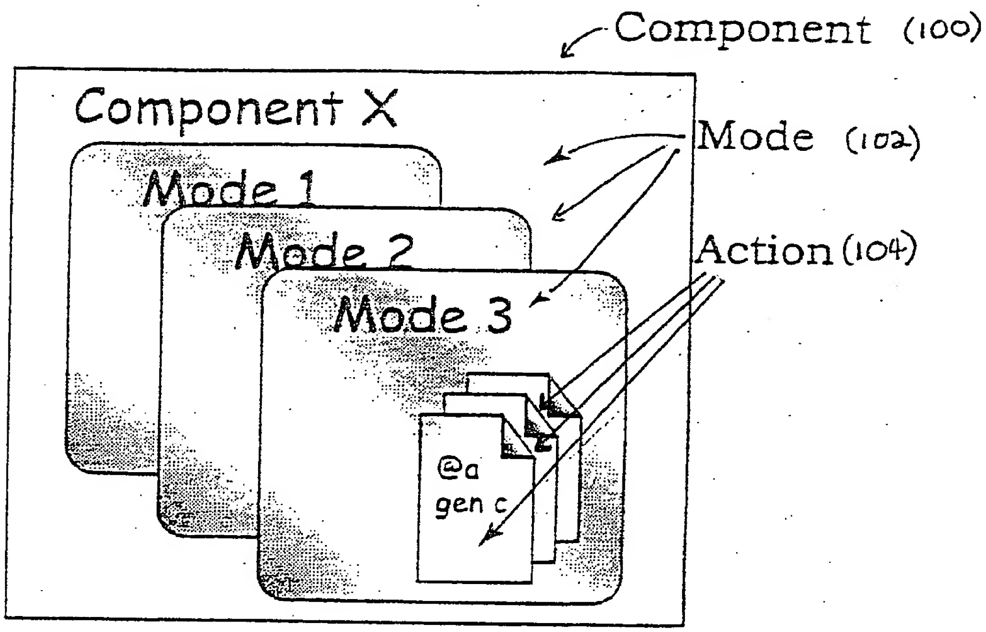

Component (100)
Component X
Mode (102)
Action (104)
Mode 1
Mode 2
Mode 3
@a
gen c

Figure 1

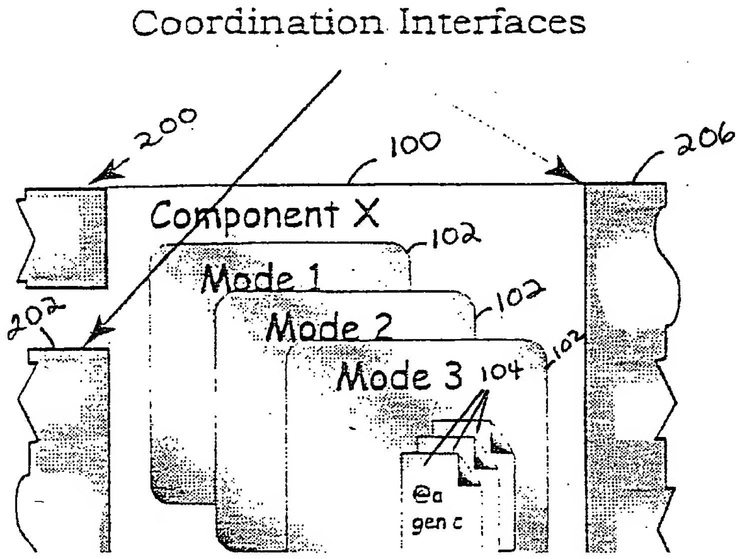

Coordination Interfaces
200
100
206
Component X
102
Mode 1
102
202
Mode 2
102
Mode 3
104
@a
gen c

Figure 2

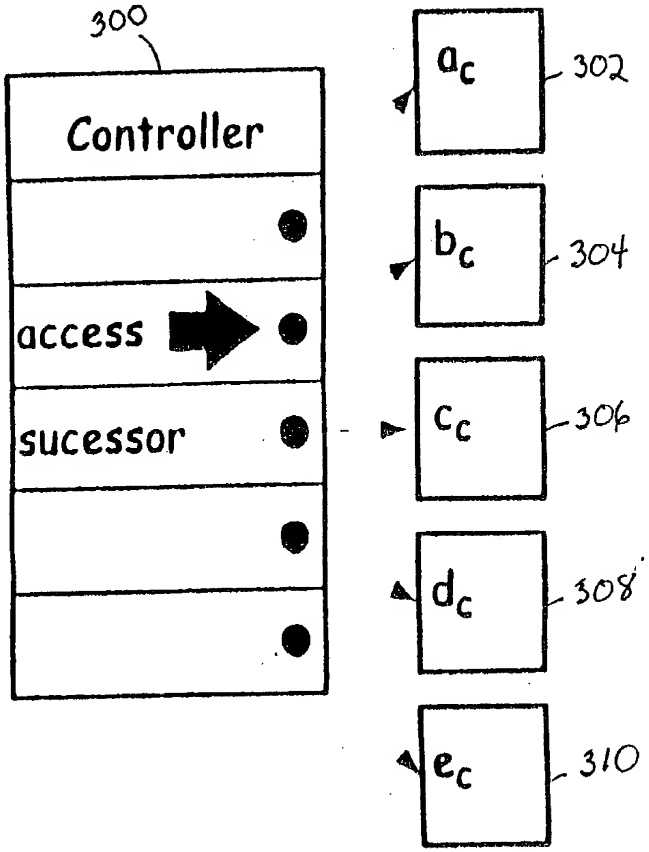


Figure 3A

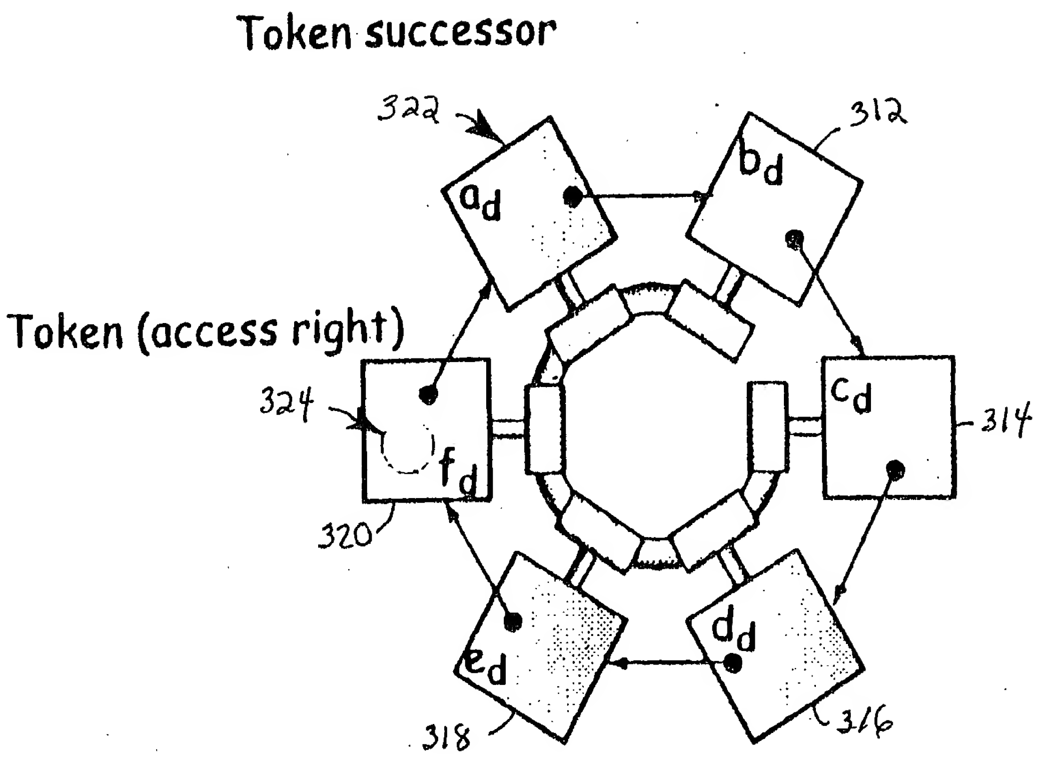


Figure 3B

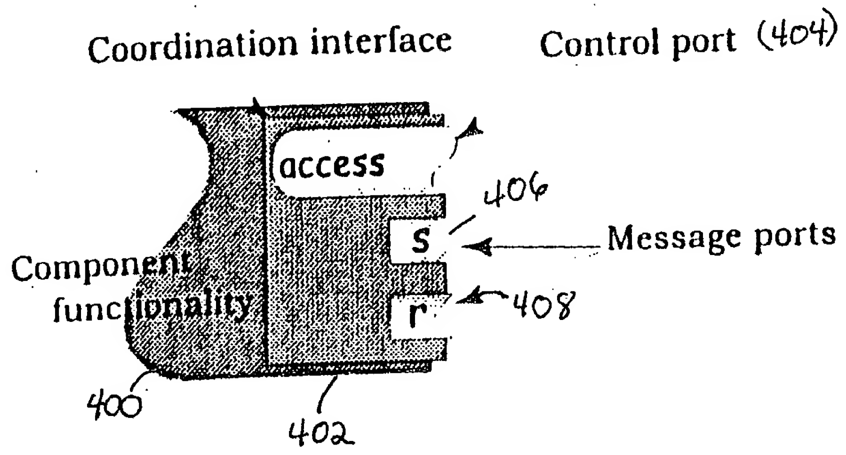


Figure 4A

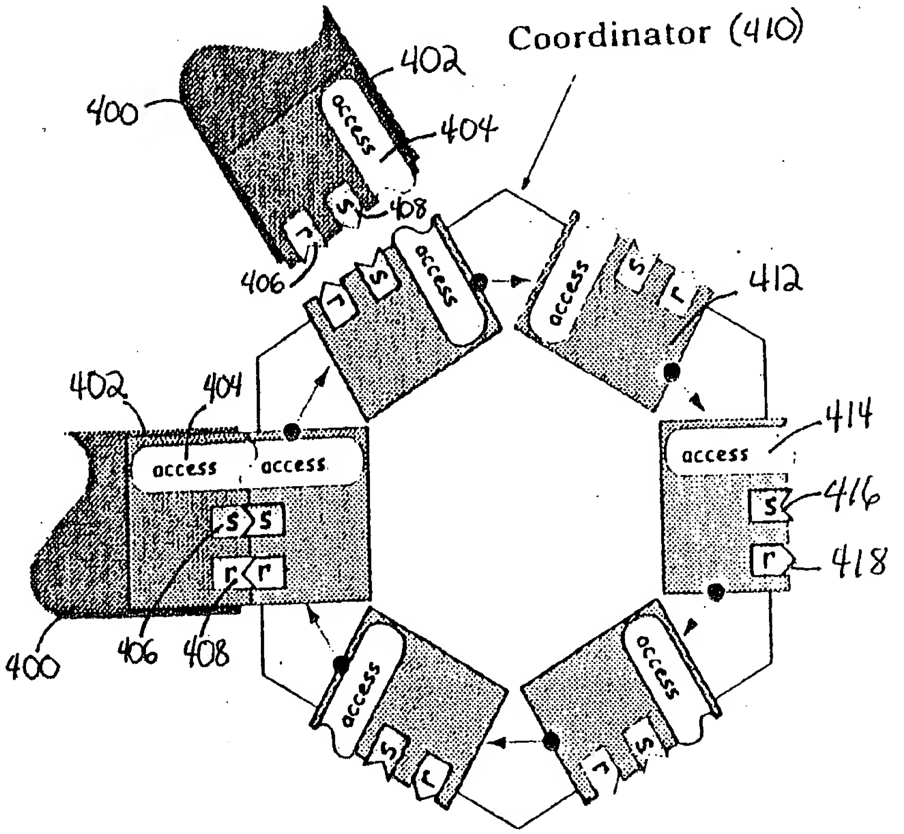


Figure 4B

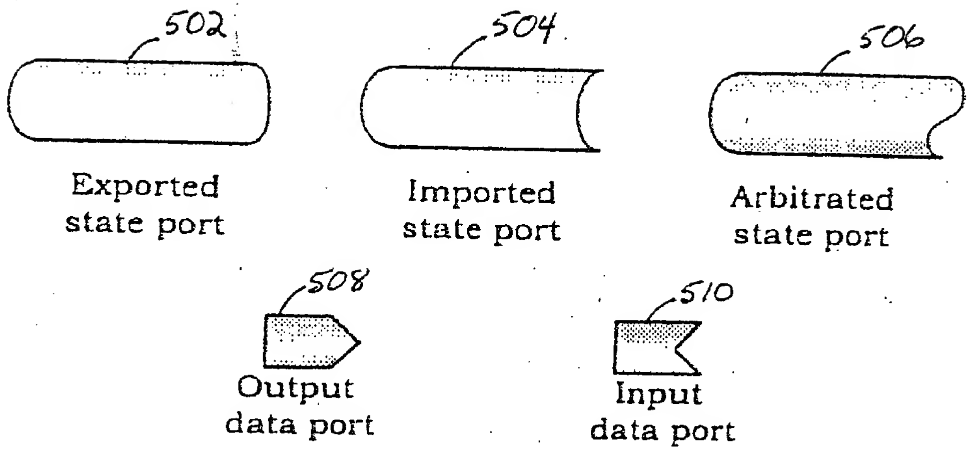

502
504
506
Exported state port
Imported state port
Arbitrated state port
508
510
Output data port
Input data port

Figure 5

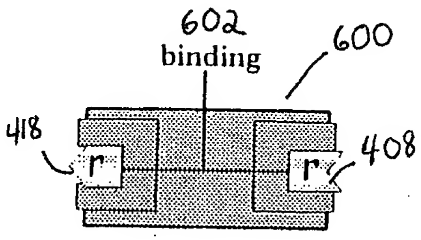


Figure 6A

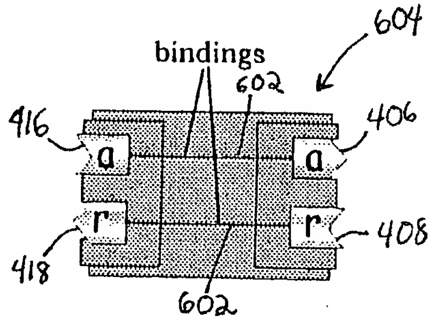


Figure 6B

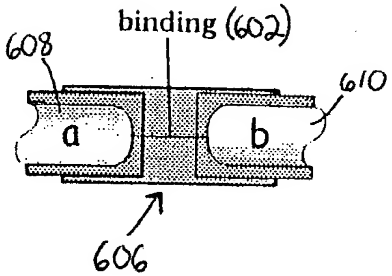


Figure 6C

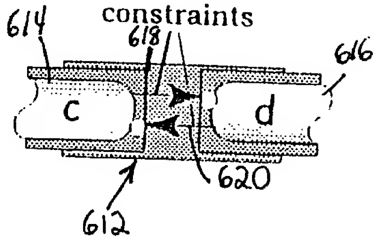
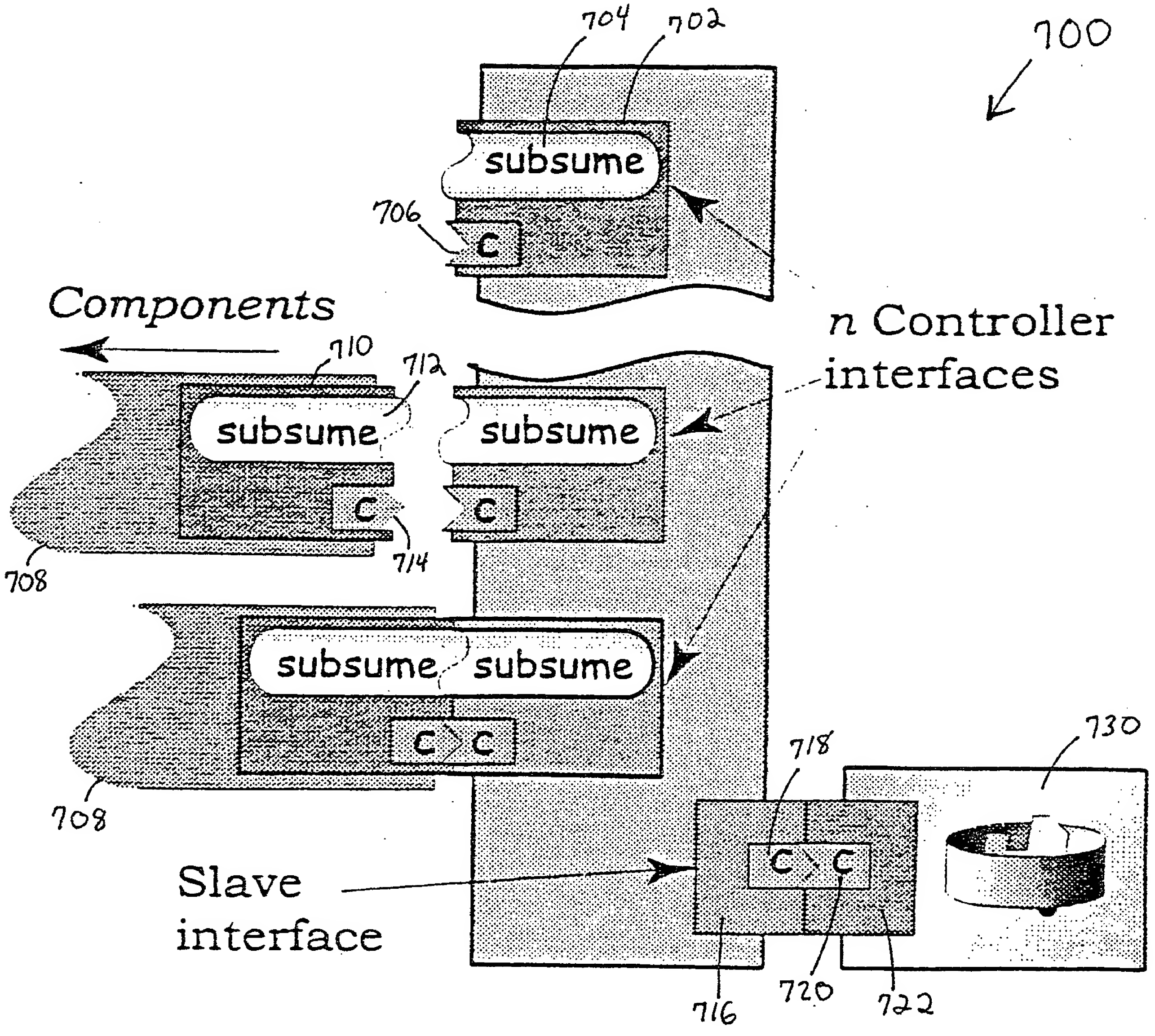


Figure 6D



700
704
702
subsume
706
C
Components
n Controller interfaces
710
712
subsume
subsume
C
C
714
708
subsume
subsume
C > C
708
730
718
Slave interface
C > C
716
720
722

Figure 7

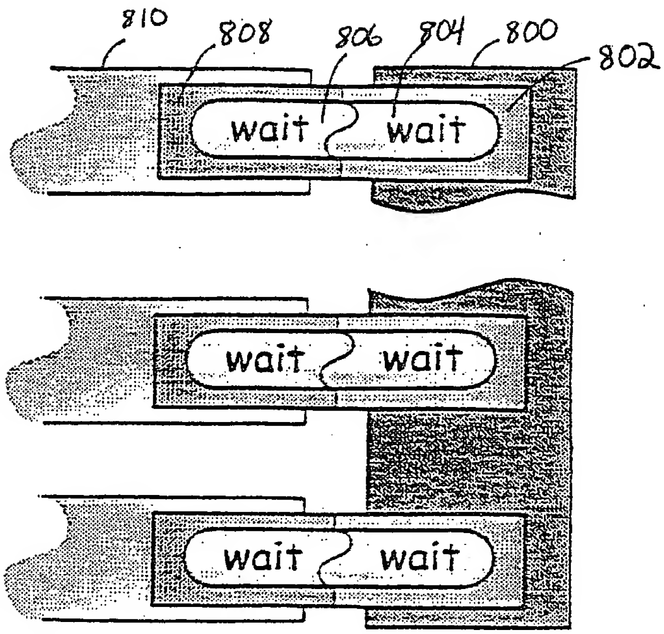


Figure 8

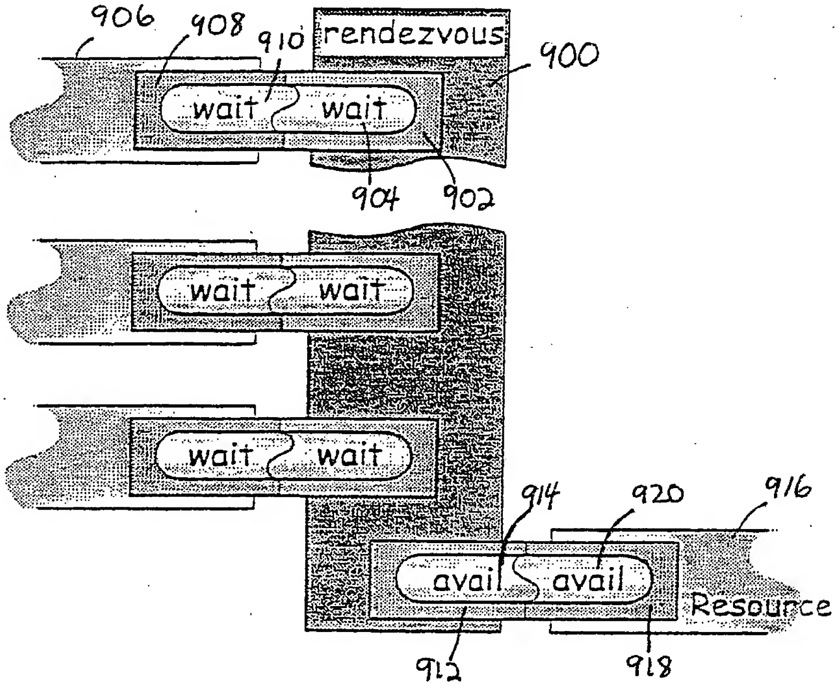

906
908
910
rendezvous
900
wait
wait
904
902
wait
wait
wait
wait
914
920
916
avail
avail
Resource
912
918

Figure 9

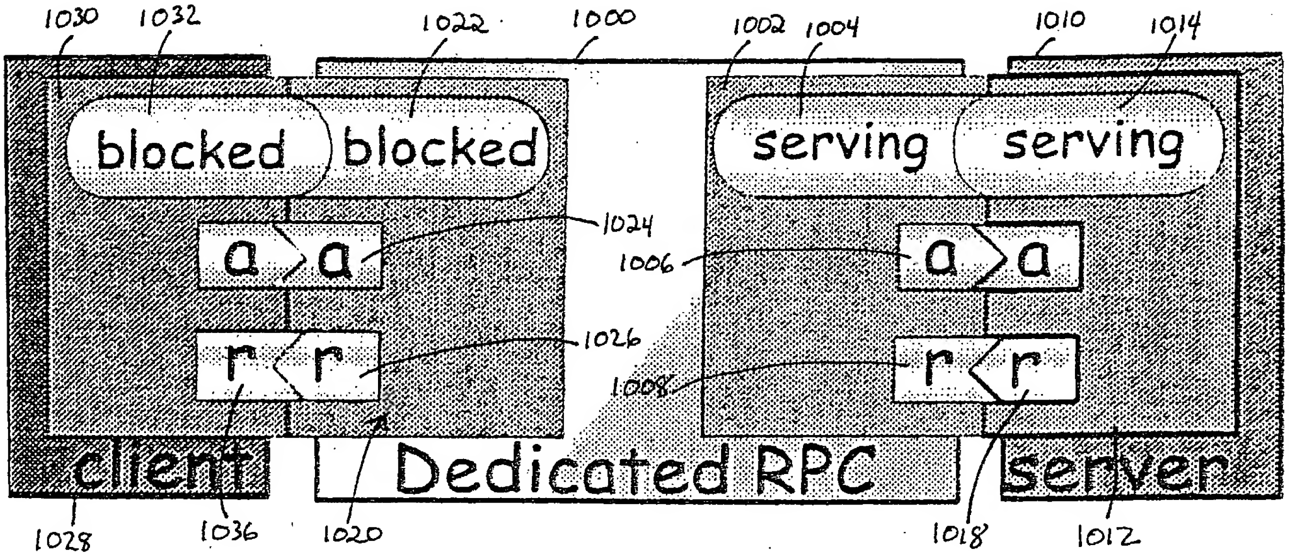

1030
1032
1022
1000
1002
1004
1010
1014
blocked
blocked
serving
serving
a
a
1024
1006
a
a
r
r
1026
1008
r
r
client
Dedicated RPC
server
1028
1036
1020
1018
1012

Figure 10

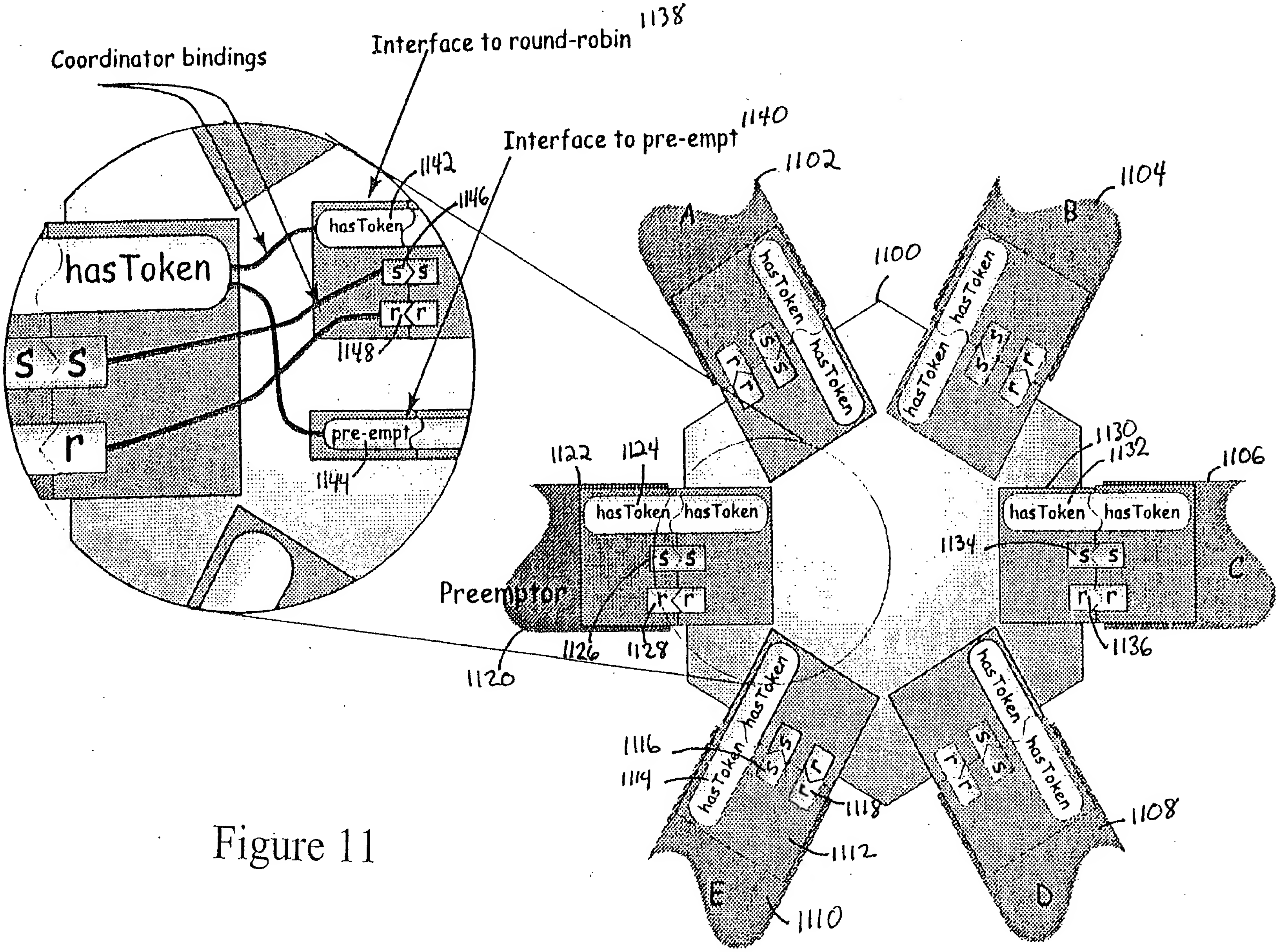

Coordinator bindings
Interface to round-robin
1138
Interface to pre-empt
1140
1142
1146
hasToken
s s
r r
1148
pre-empt
1144
hasToken
S S
r
Preemptor
1120
1122
1124
1126
1128
1102
A
1104
B
1100
1106
C
1130
1132
1134
1136
1108
D
1110
E
1112
1114
1116
1118
hasToken
s
r

Figure 11

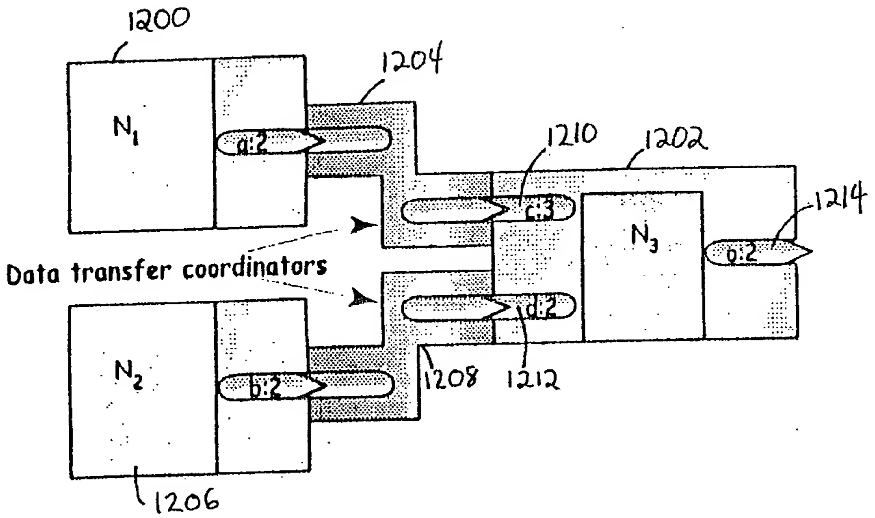


Figure 12A

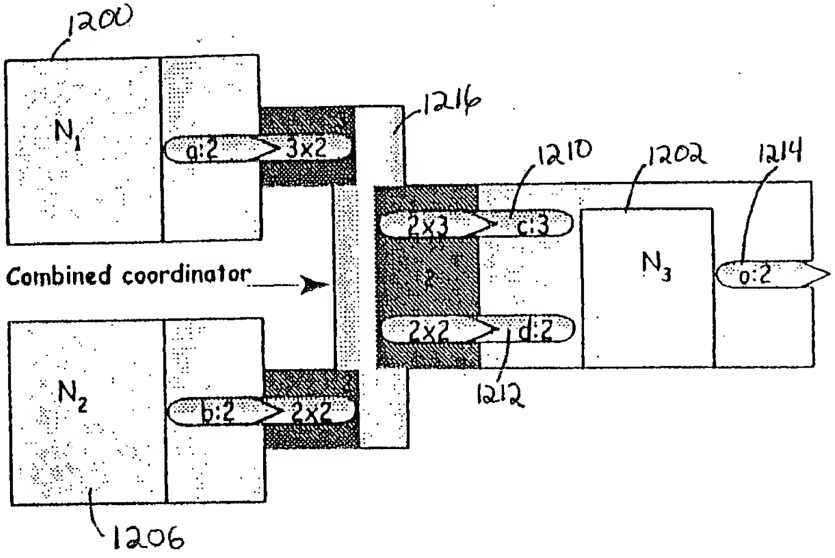


Figure 12B

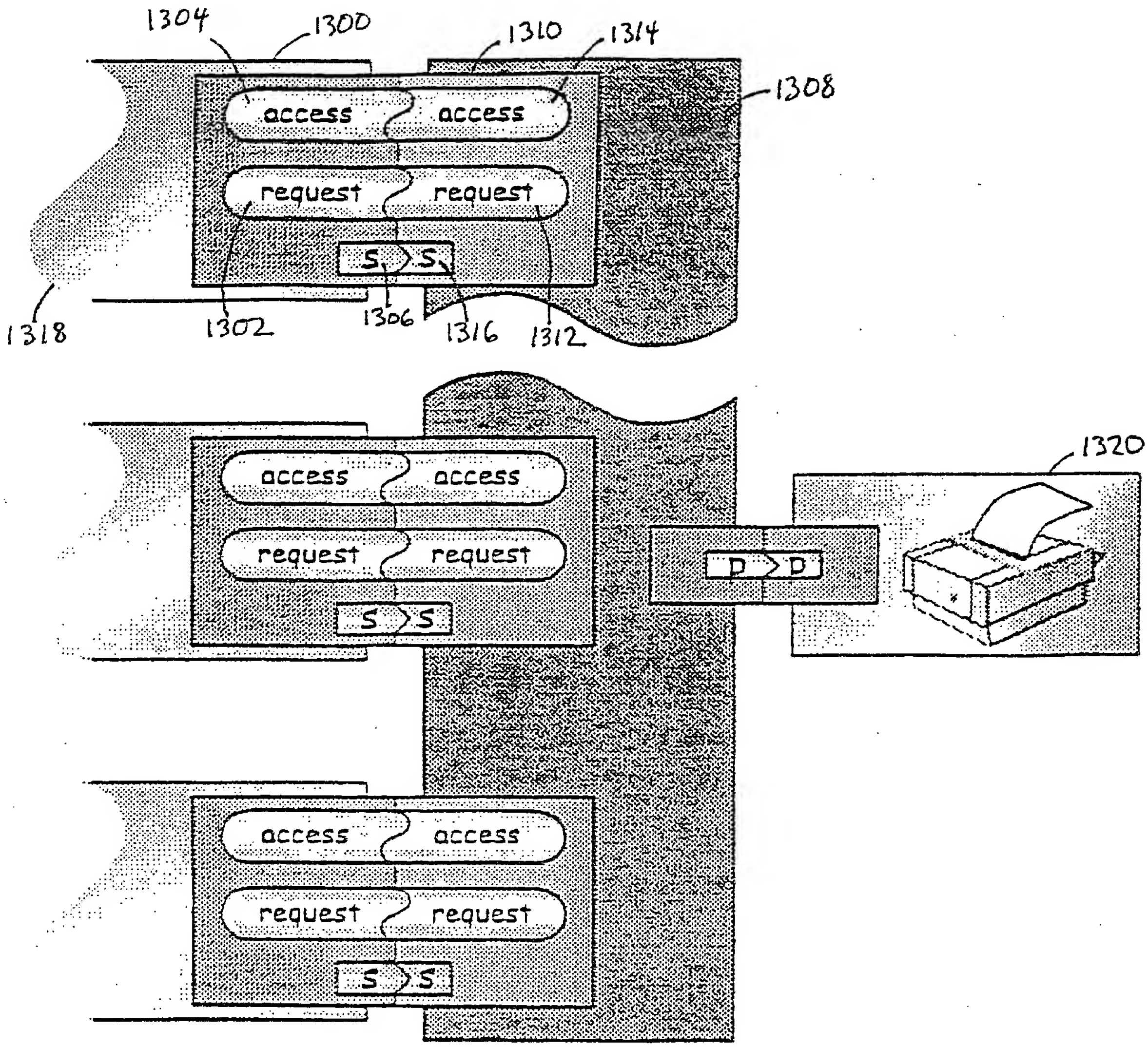

1304
1300
1310
1314
1308
access
access
request
request
S
S
1318
1302
1306
1316
1312
1320
access
access
request
request
S
S
D
D
access
access
request
request
S
S

Figure 13

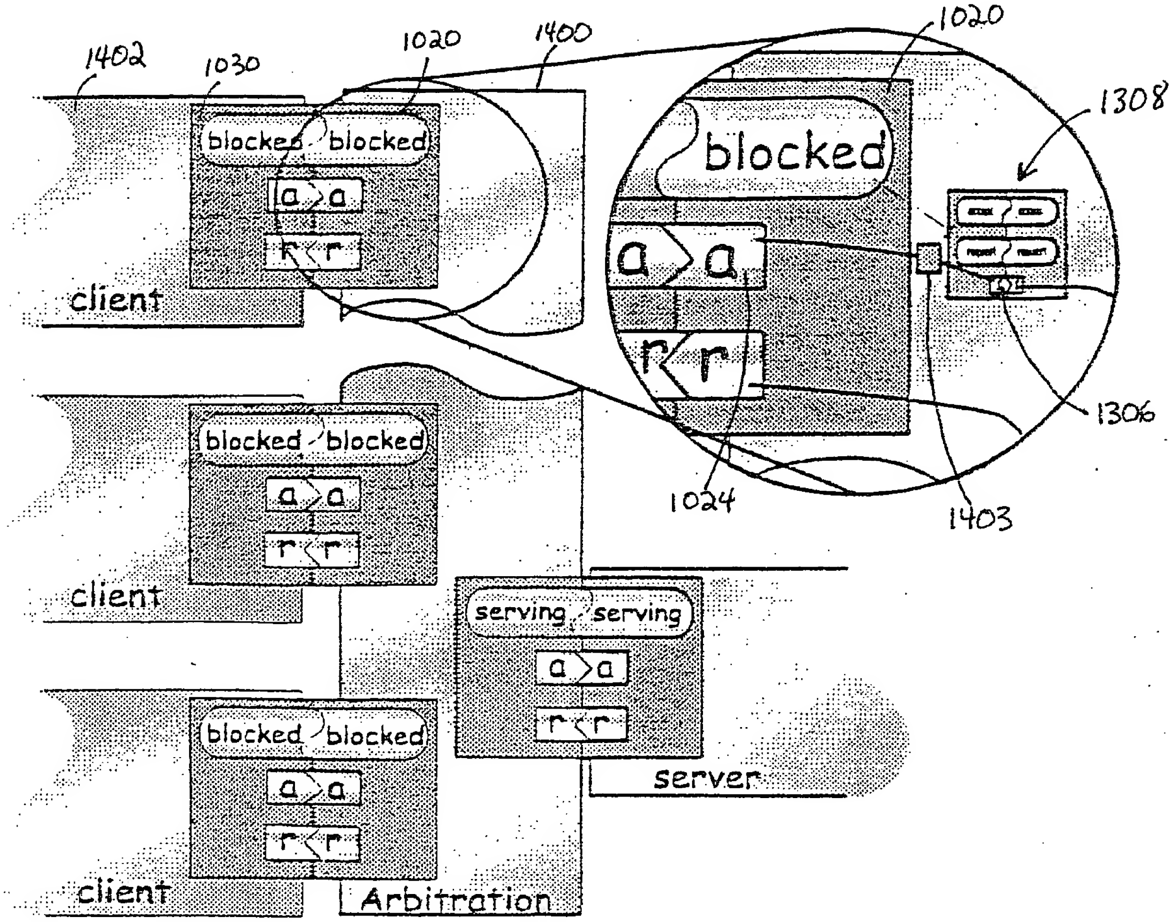

1402
1030
1020
1400
1020
1308
blocked
blocked
blocked
a
a
r
r
client
blocked
blocked
a
a
r
r
client
serving
serving
a
a
r
r
server
blocked
blocked
a
a
r
r
client
Arbitration
1306
1024
1403

Figure 14

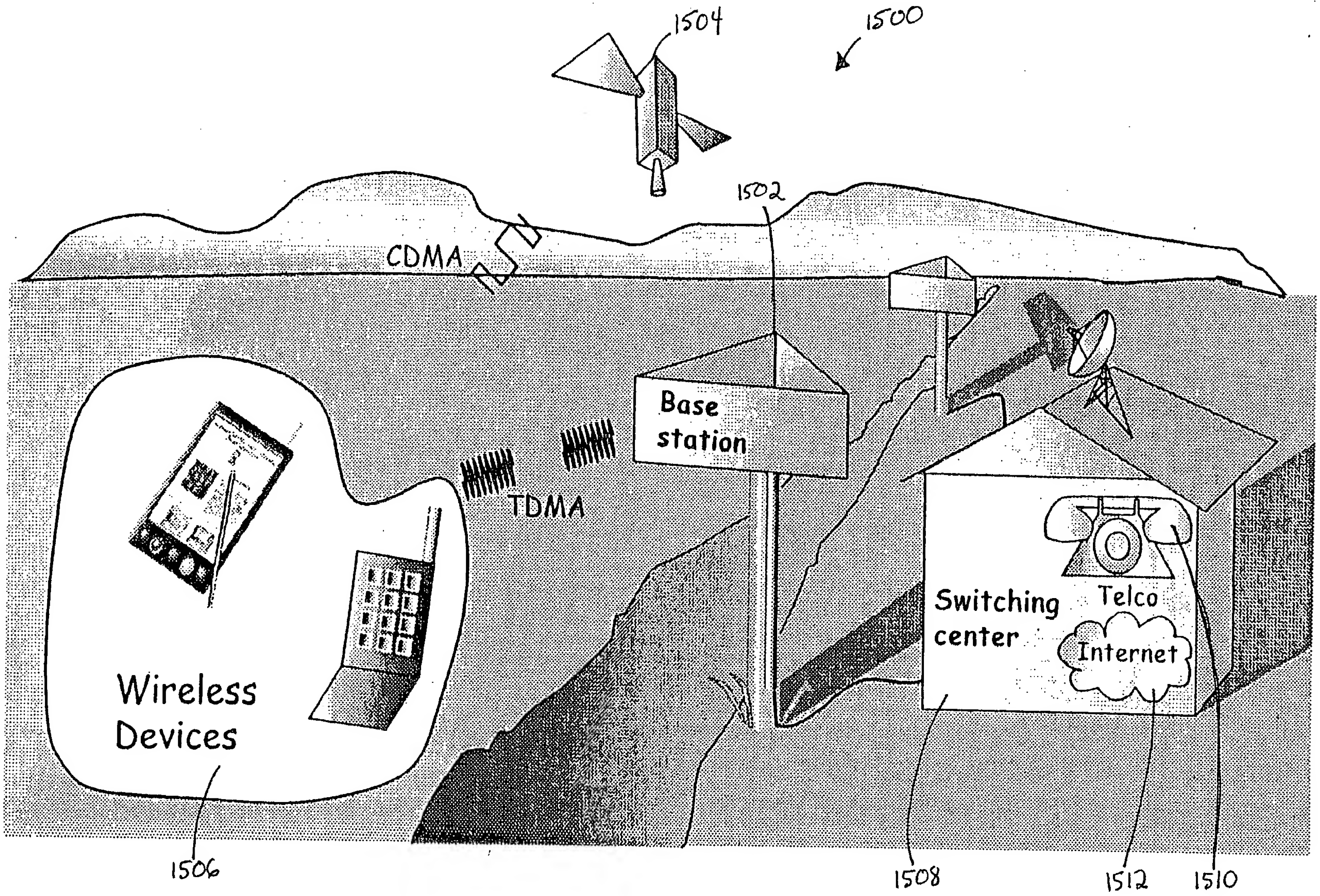

1504
1500
1502
CDMA
TDMA
Base
station
Wireless
Devices
Switching
center
Telco
Internet
1506
1508
1512
1510

Figure 15

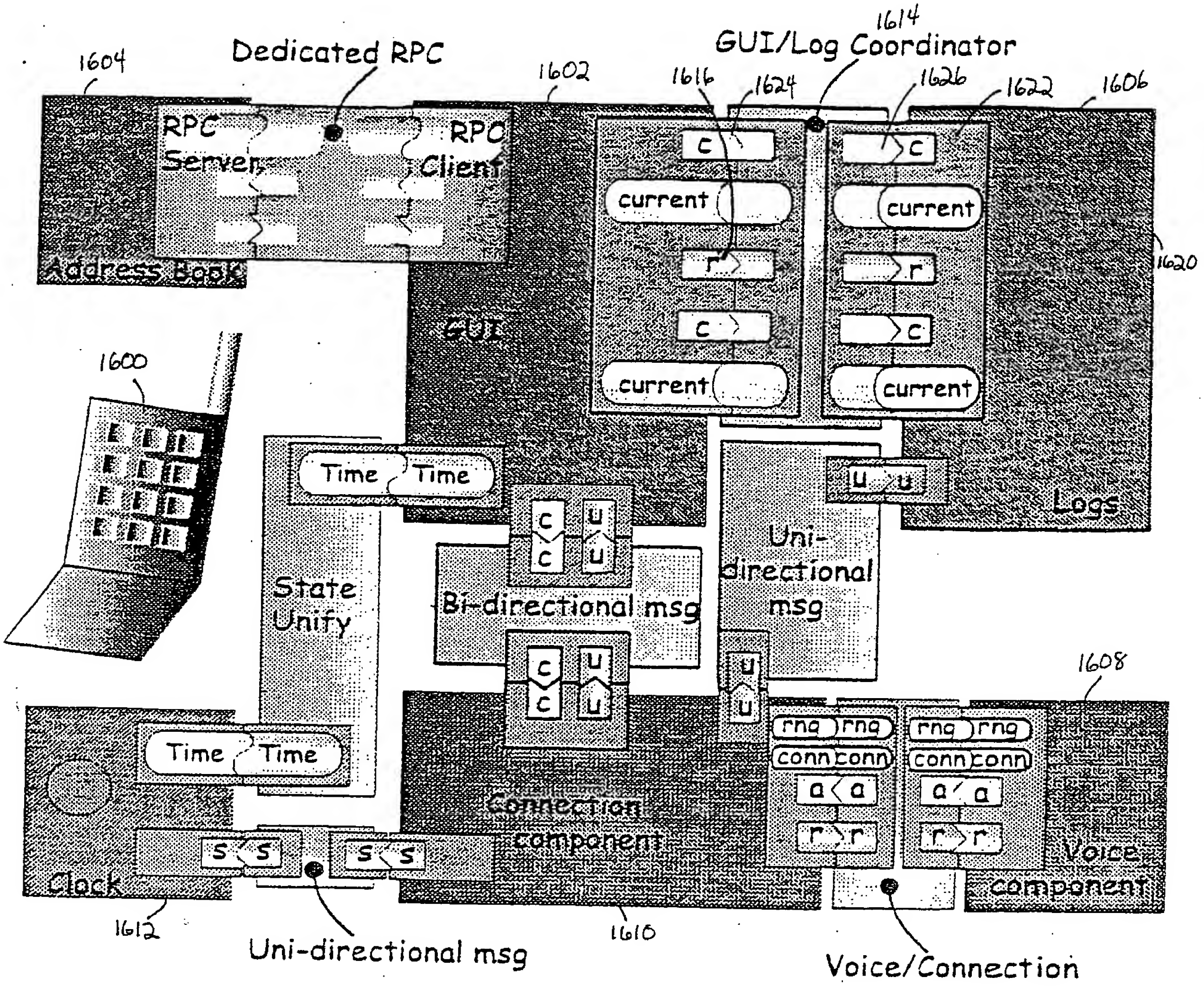

1604
Dedicated RPC
1602
1616
1624
1614
GUI/Log Coordinator
1626
1622
1606
RPC Server
RPC Client
Address Book
c
current
r
c
current
c
current
r
c
current
1620
GUI
Logs
1600
Time
Time
c
c
u
u
u
u
State Unify
Bi-directional msg
Uni-directional msg
c
c
u
u
u
u
1608
Time
Time
rng
rng
rng
rng
conn
conn
conn
conn
a
a
a
a
r
r
r
r
Connection component
Voice component
s
s
s
s
Clock
1612
Uni-directional msg
1610
Voice/Connection

Figure 16

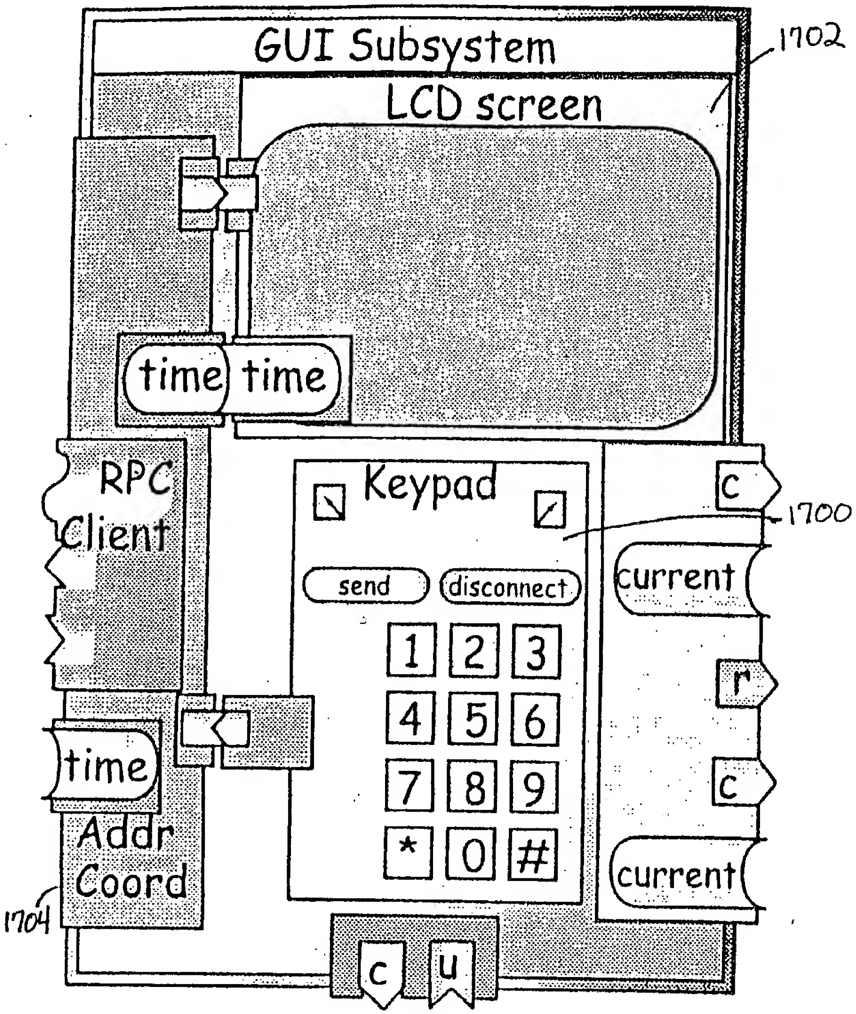


Figure 17A

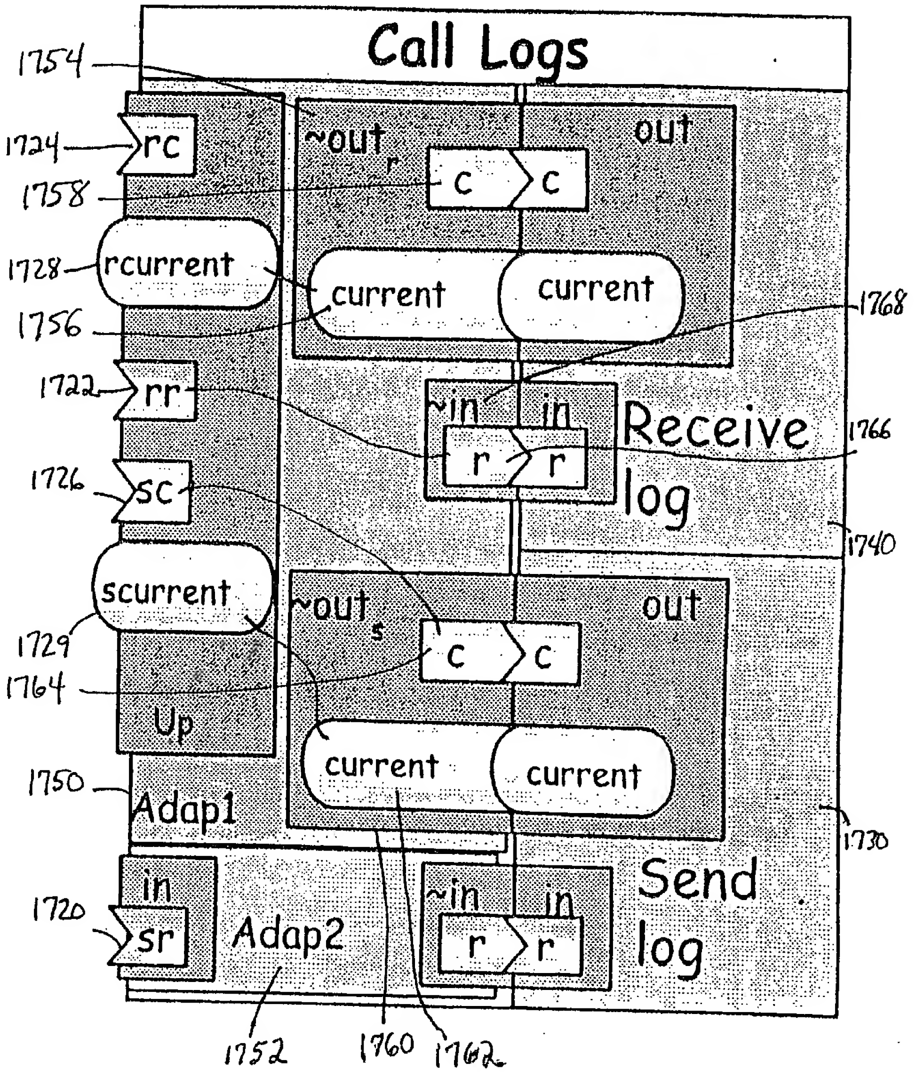


Figure 17B

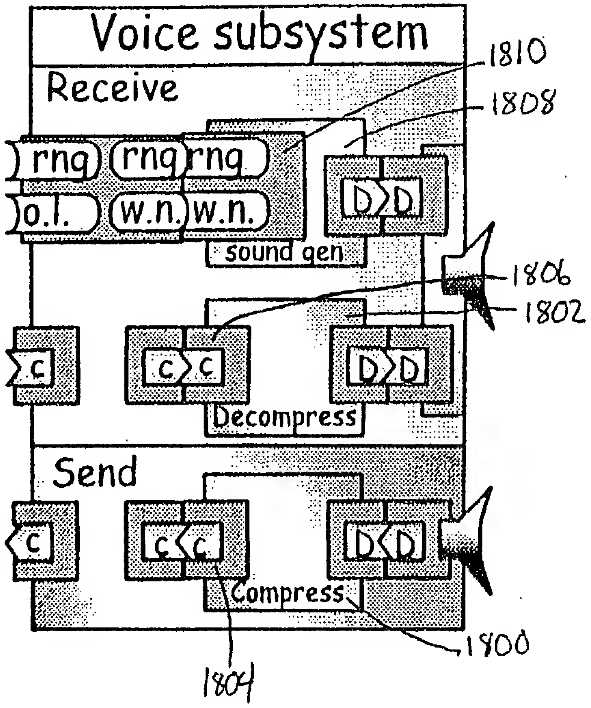


Figure 18A

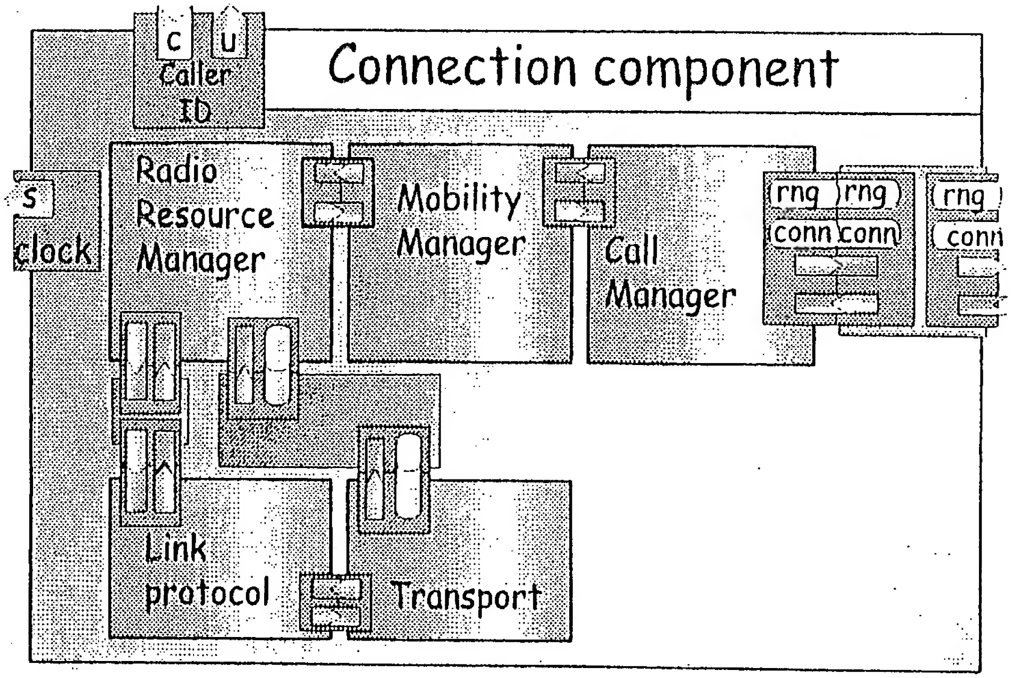


Figure 18B

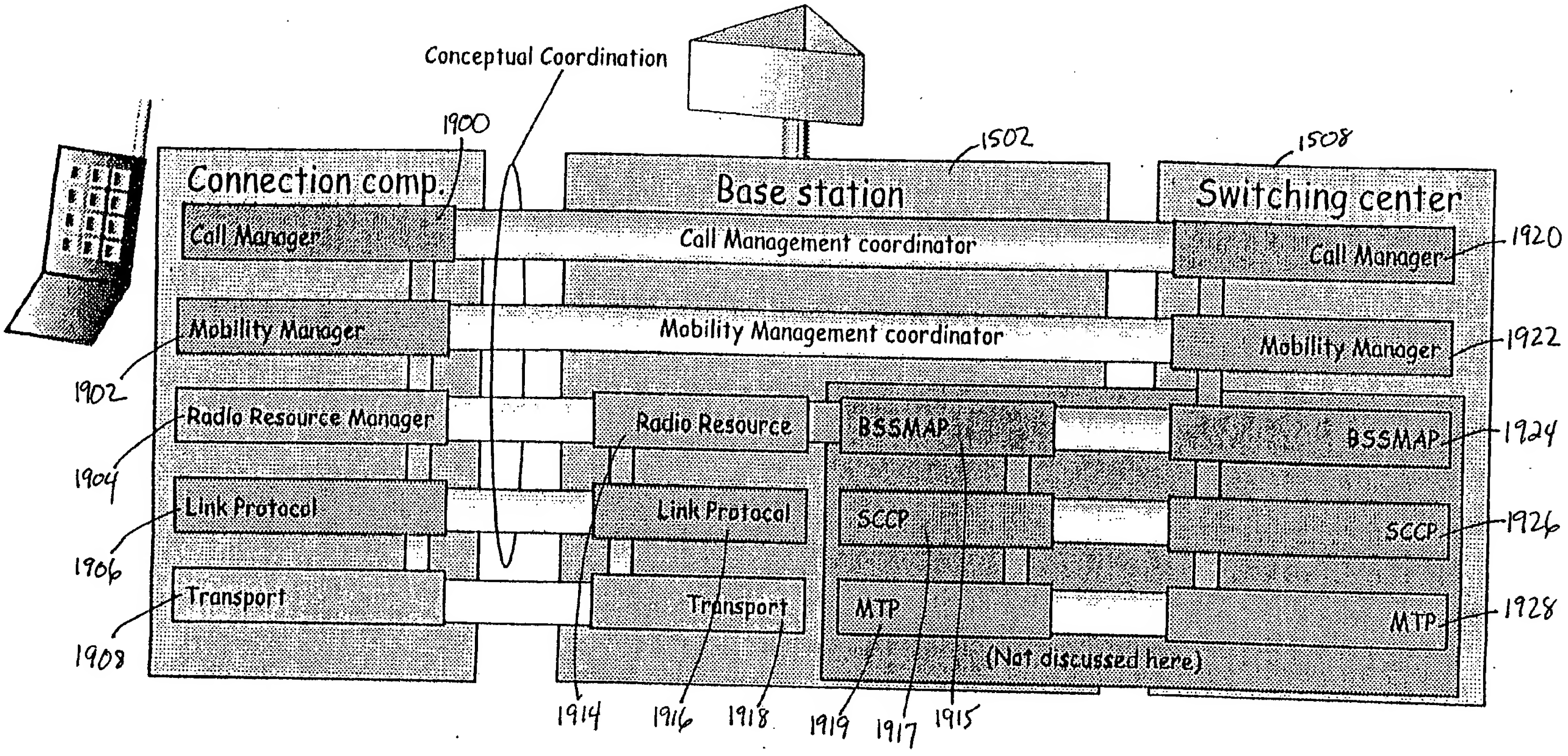

Conceptual Coordination
1900
1502
1508
Connection comp.
Base station
Switching center
Call Manager
Call Management coordinator
Call Manager
1920
Mobility Manager
Mobility Management coordinator
Mobility Manager
1922
1902
Radio Resource Manager
Radio Resource
BSSMAP
BSSMAP
1924
1904
Link Protocol
Link Protocol
SCCP
SCCP
1926
1906
Transport
Transport
MTP
MTP
1928
1908
(Not discussed here)
1914
1916
1918
1919
1917
1915

Figure 19

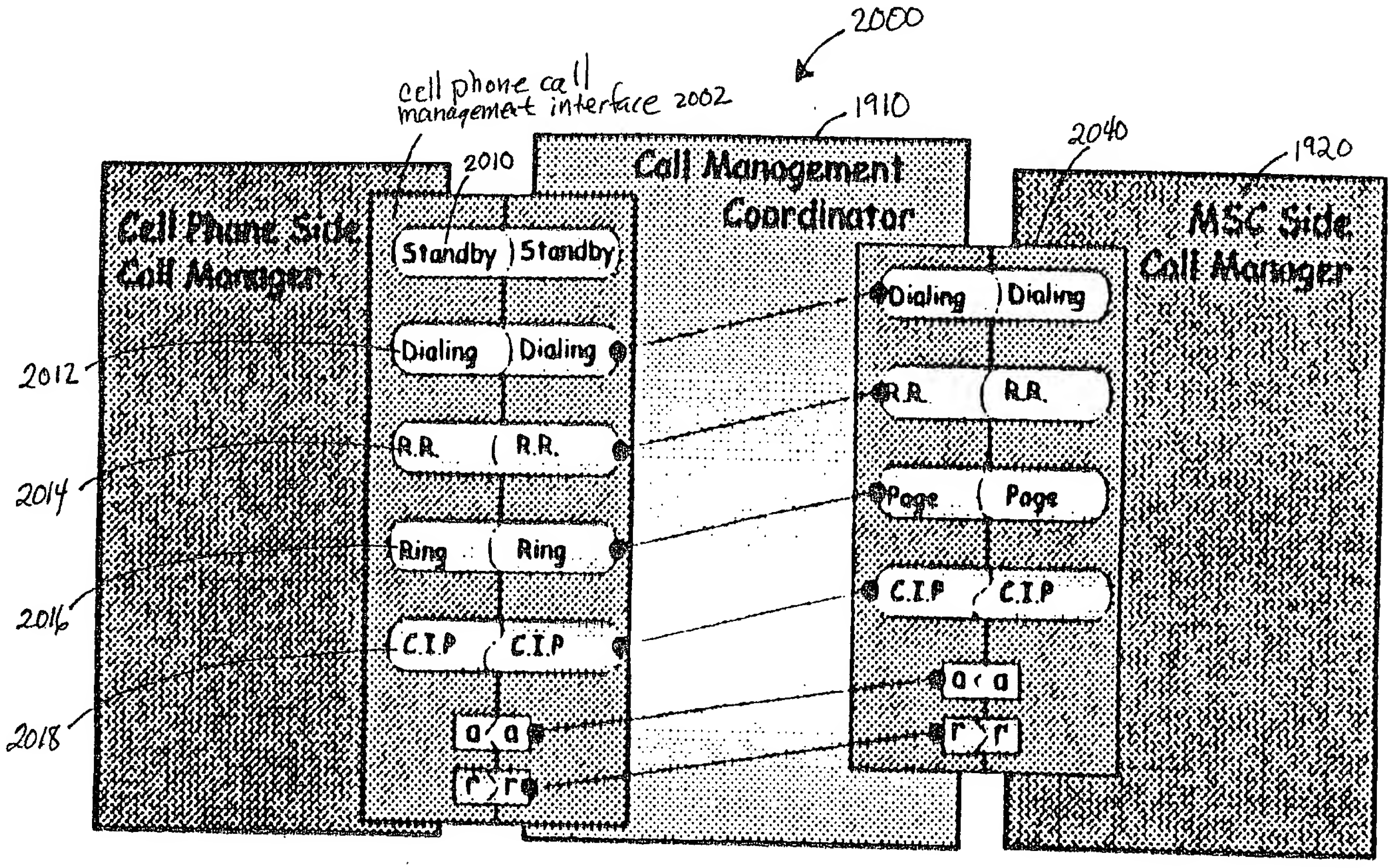

2000
cell phone call management interface 2002
1910
2040
1920
2010
Cell Phone Side Call Manager
Call Management Coordinator
MSC Side Call Manager
Standby
Standby
Dialing
Dialing
R.R.
R.R.
Ring
Ring
C.I.P
C.I.P
a
a
r
r
Dialing
Dialing
R.R.
R.R.
Page
Page
C.I.P
C.I.P
a
a
r
r
2012
2014
2016
2018

Figure 20

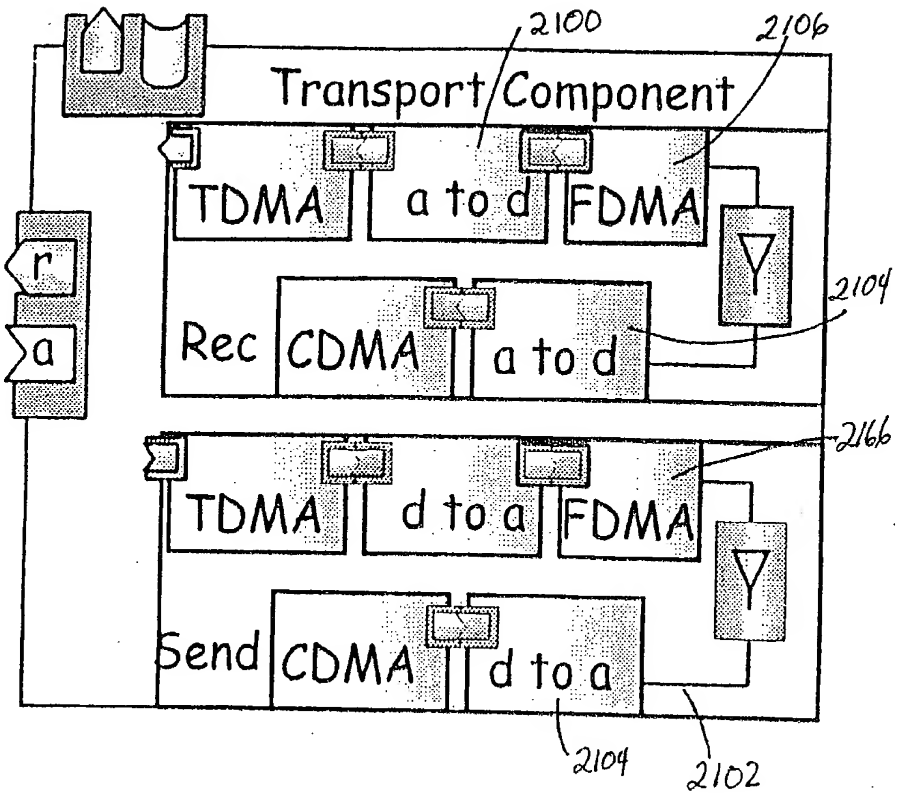


Figure 21A

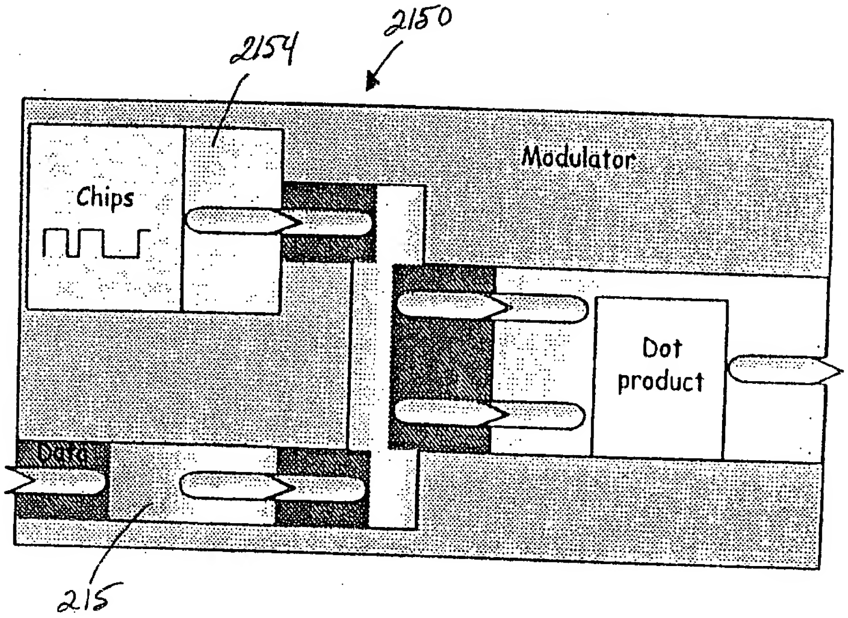


Figure 21B

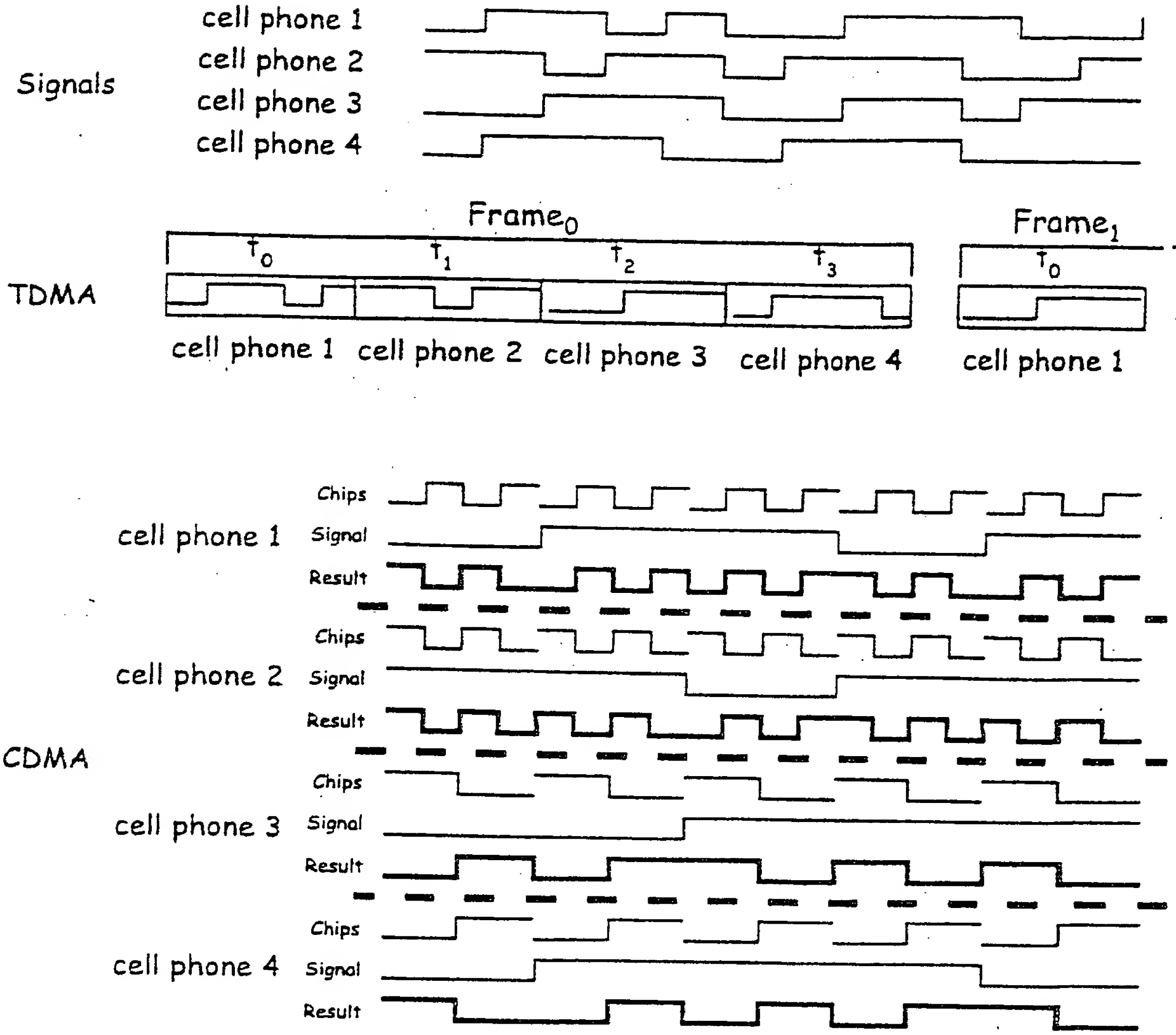

Signals
cell phone 1
cell phone 2
cell phone 3
cell phone 4
Frame$_0$
T_0
T_1
T_2
T_3
Frame$_1$
T_0
...
TDMA
cell phone 1
cell phone 2
cell phone 3
cell phone 4
cell phone 1
CDMA
cell phone 1
Chips
Signal
Result
cell phone 2
Chips
Signal
Result
cell phone 3
Chips
Signal
Result
cell phone 4
Chips
Signal
Result

Figure 22

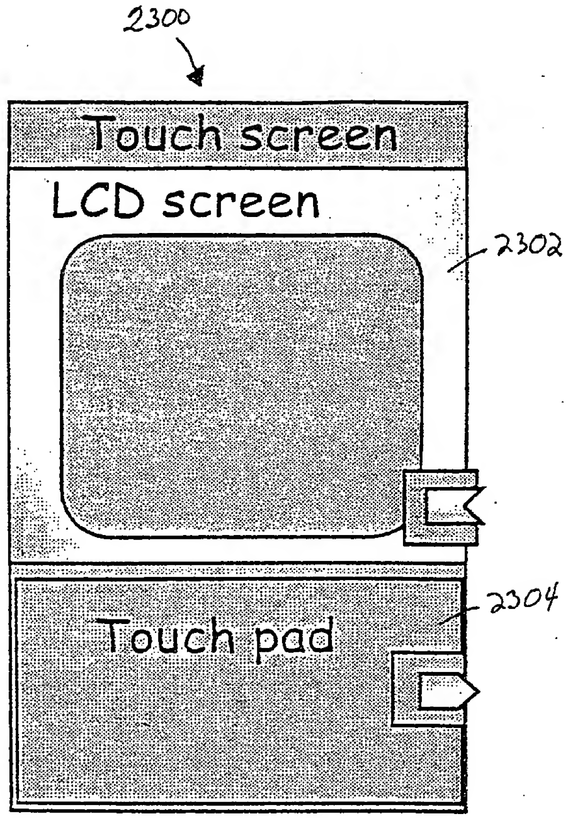


Figure 23A

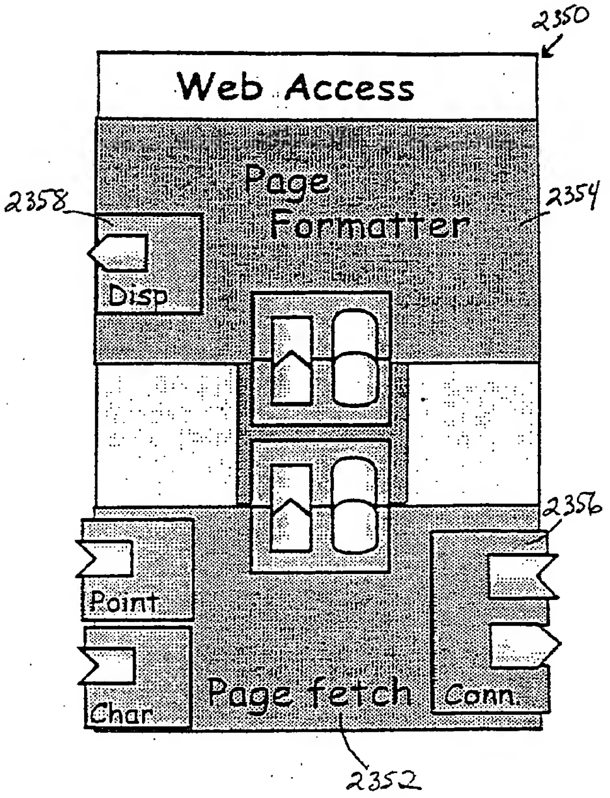


Figure 23B

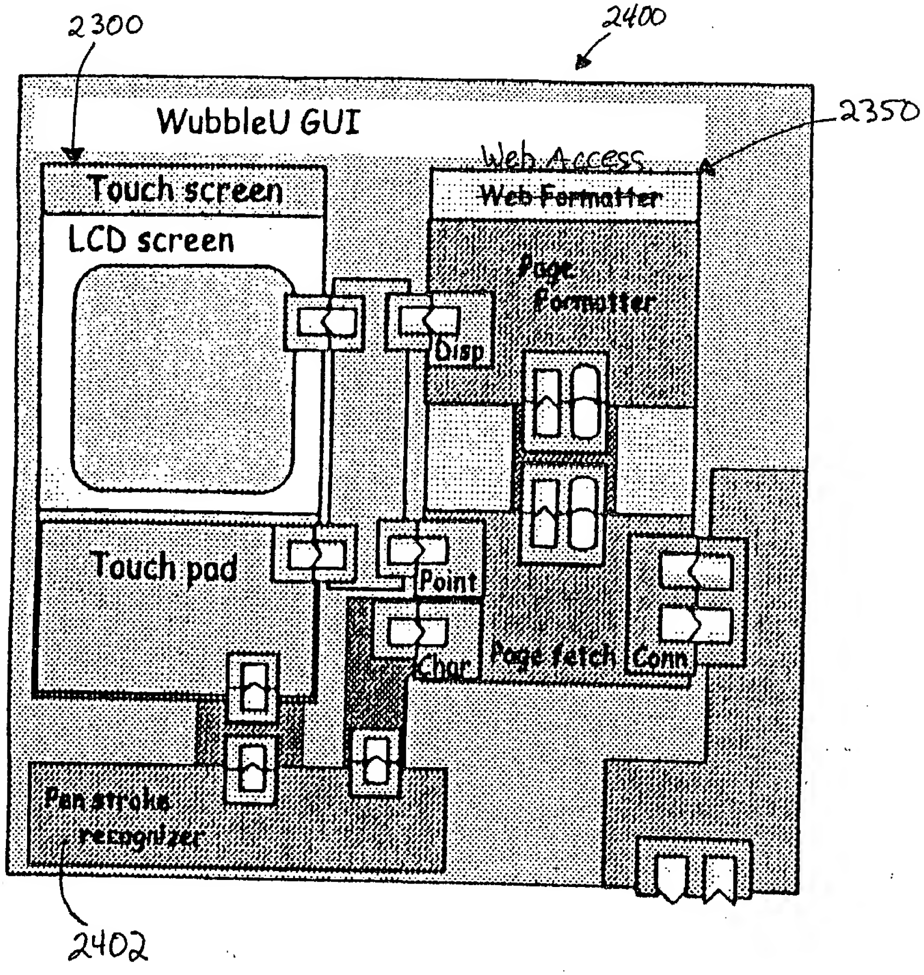


Figure 24A

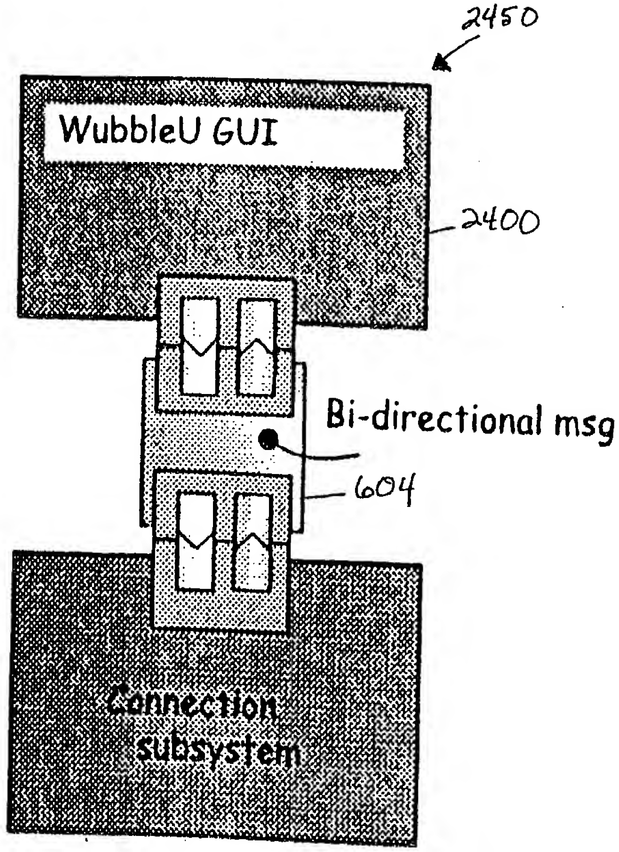


Figure 24B

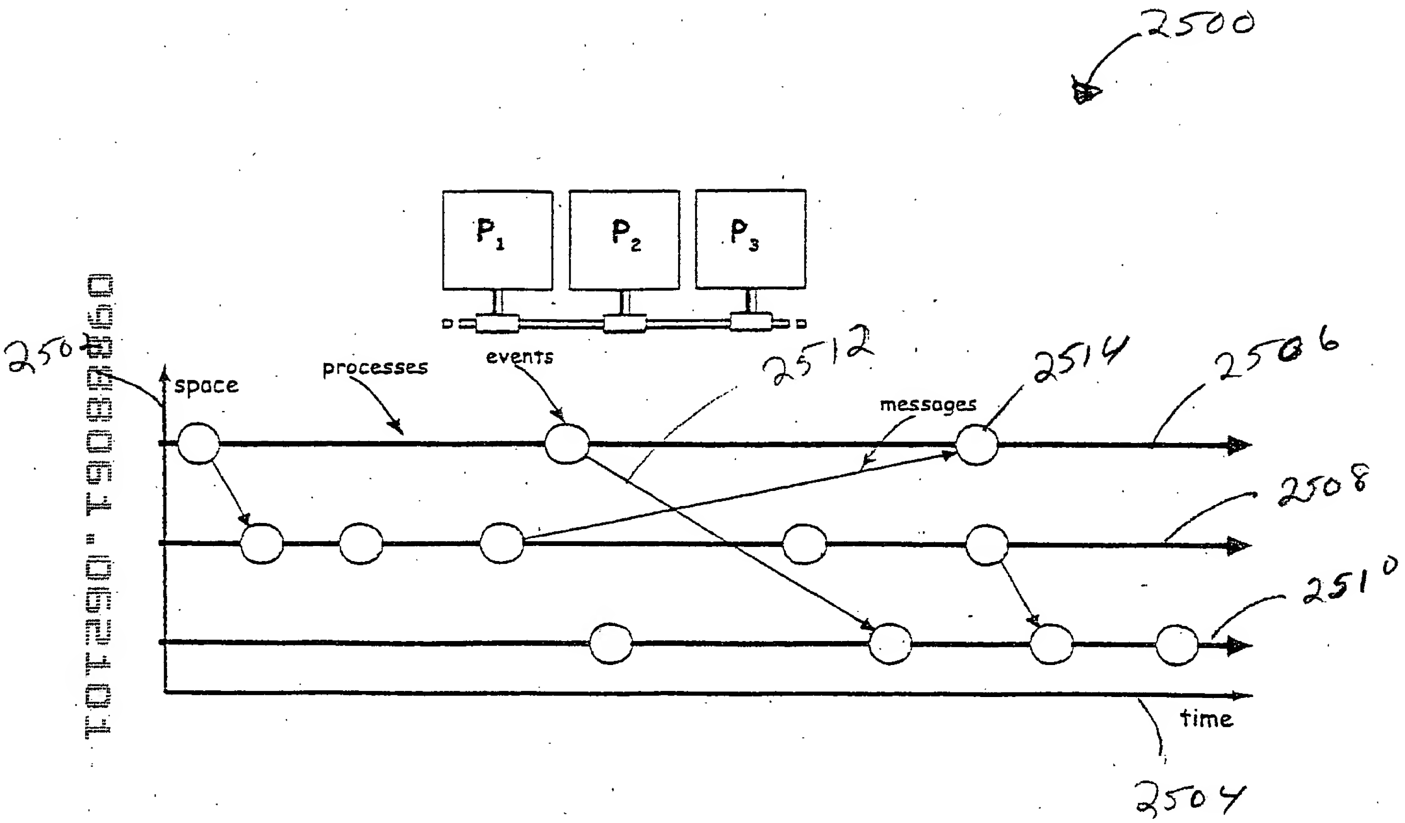


Figure 25

(prior art)

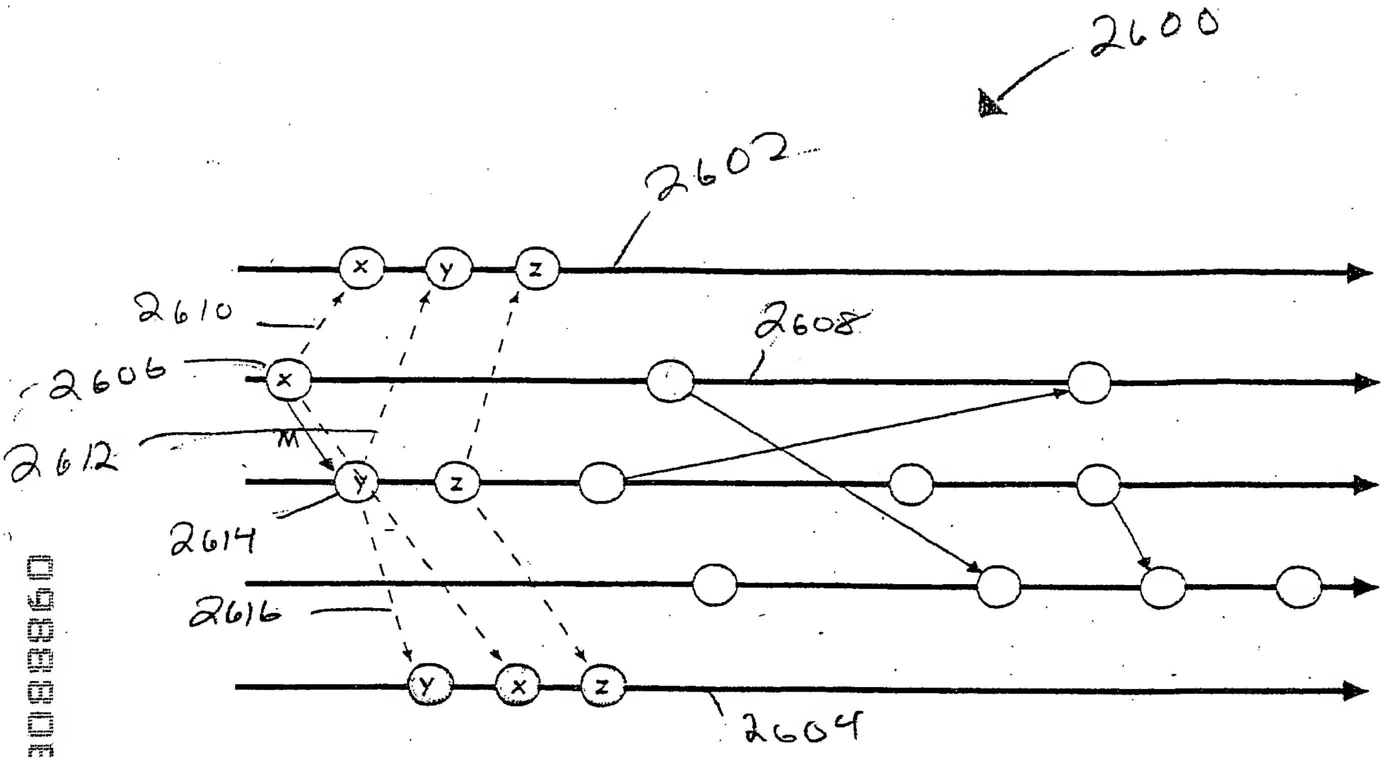


Figure 26

(prior art)

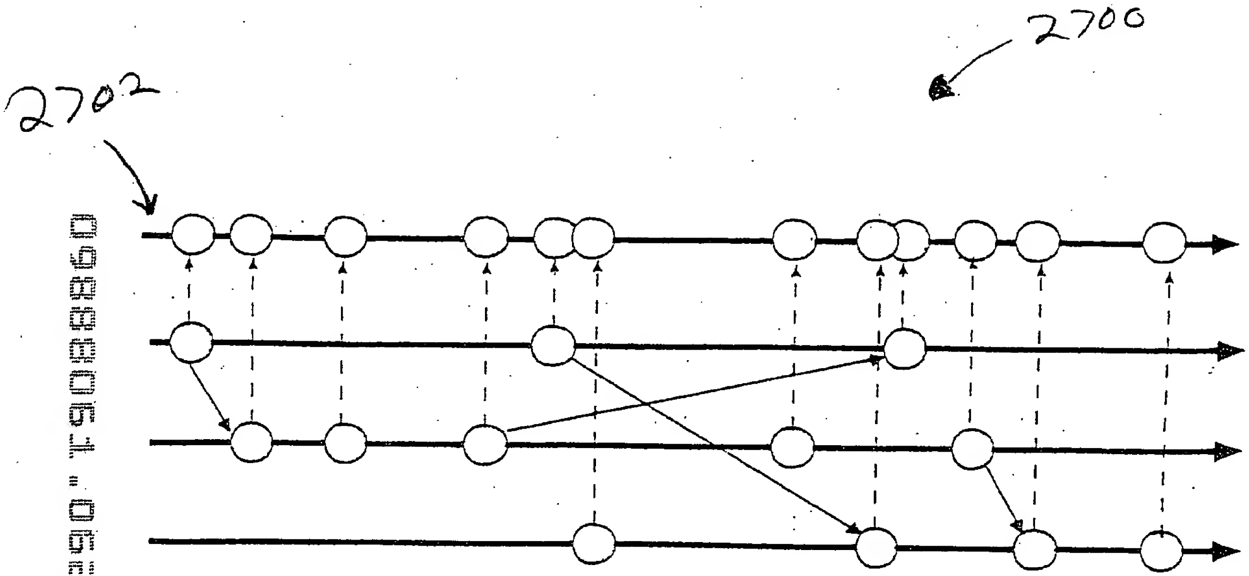


Figure 27

(prior art)

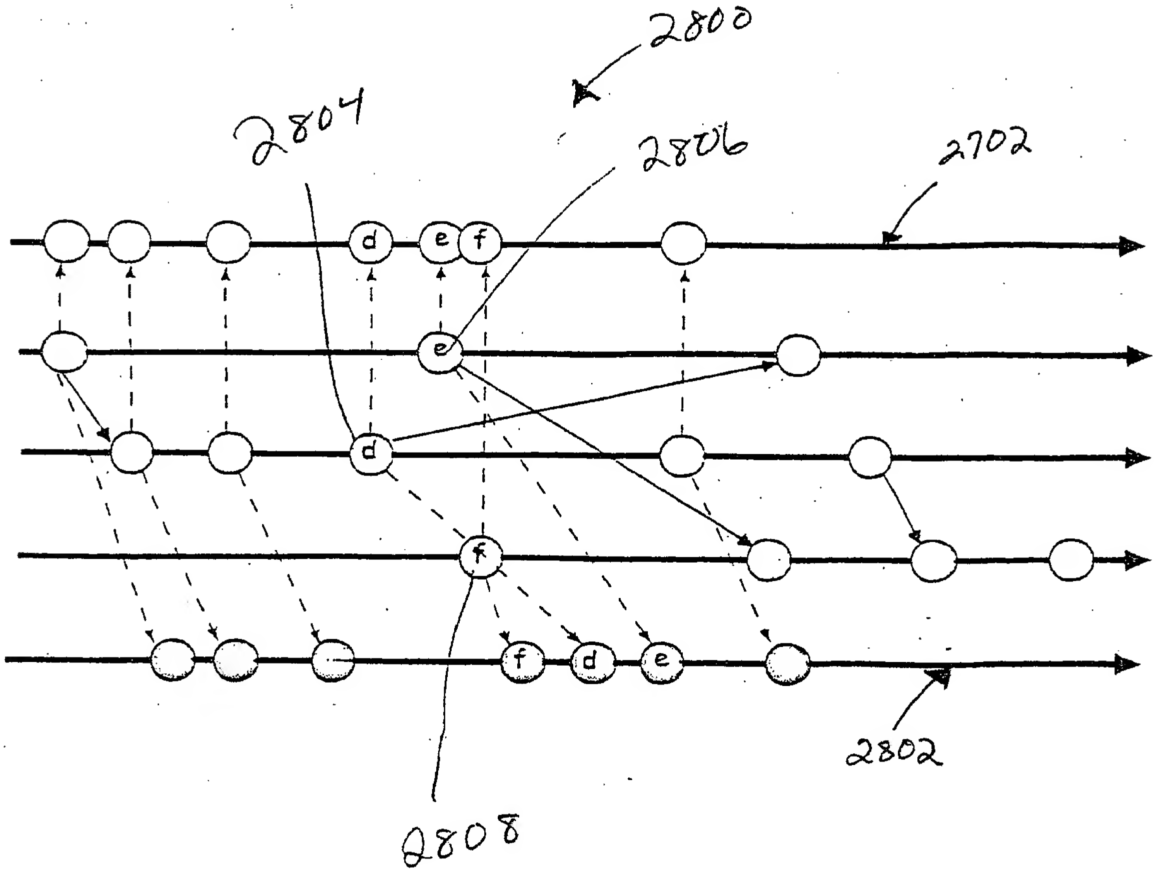


Figure 28

(prior art)

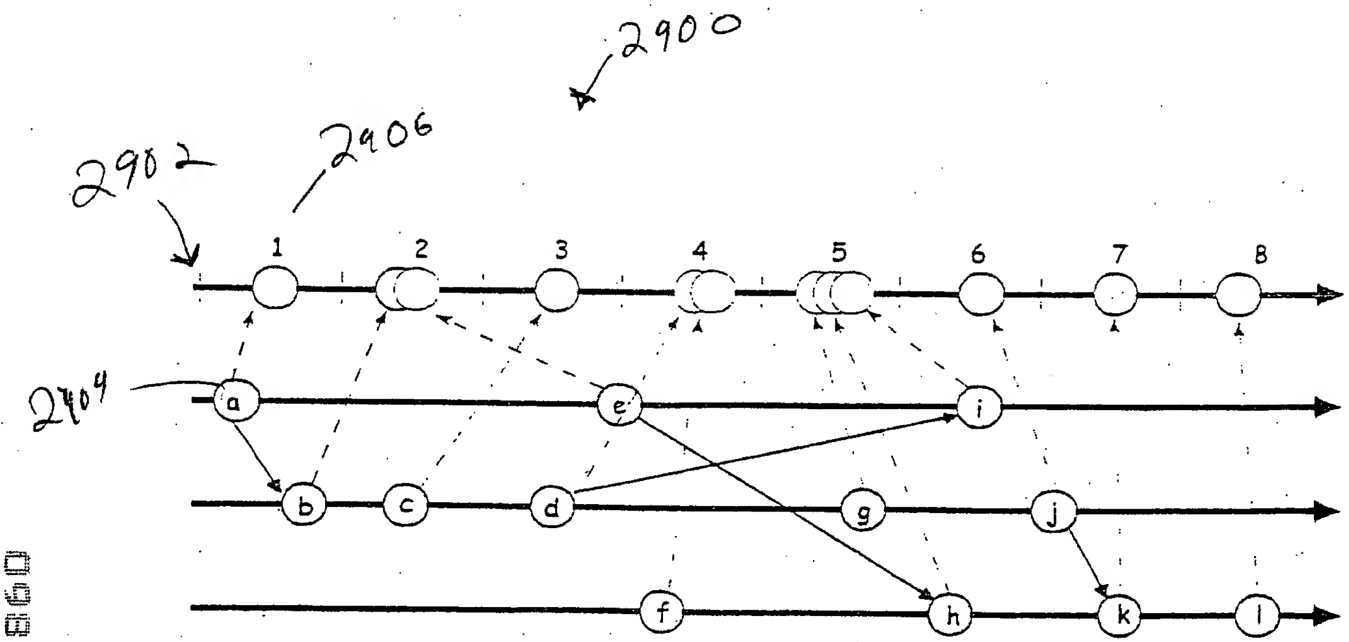


Figure 29

(prior art)

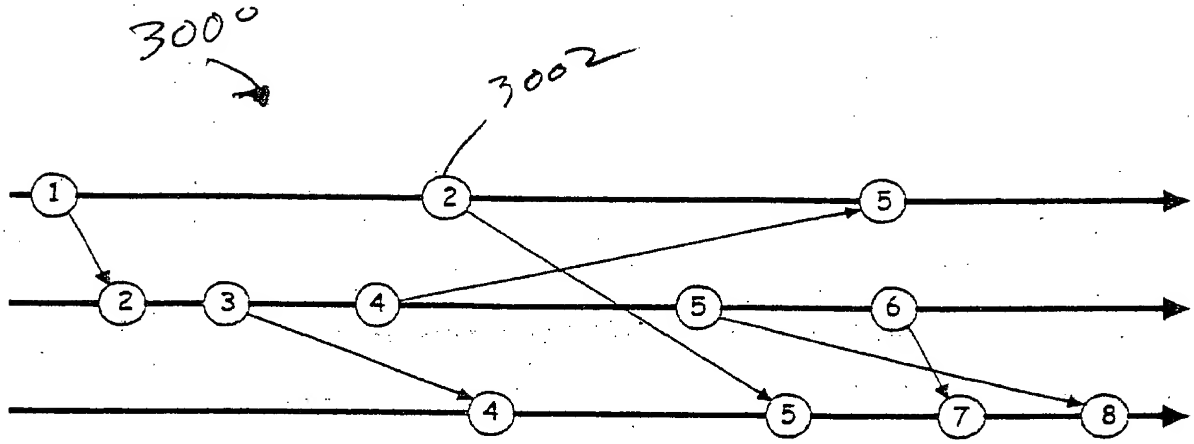


Figure 30

(prior art)

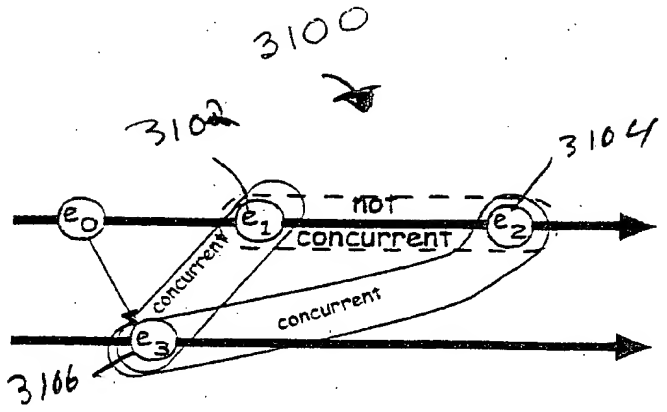


Figure 31

(prior art)

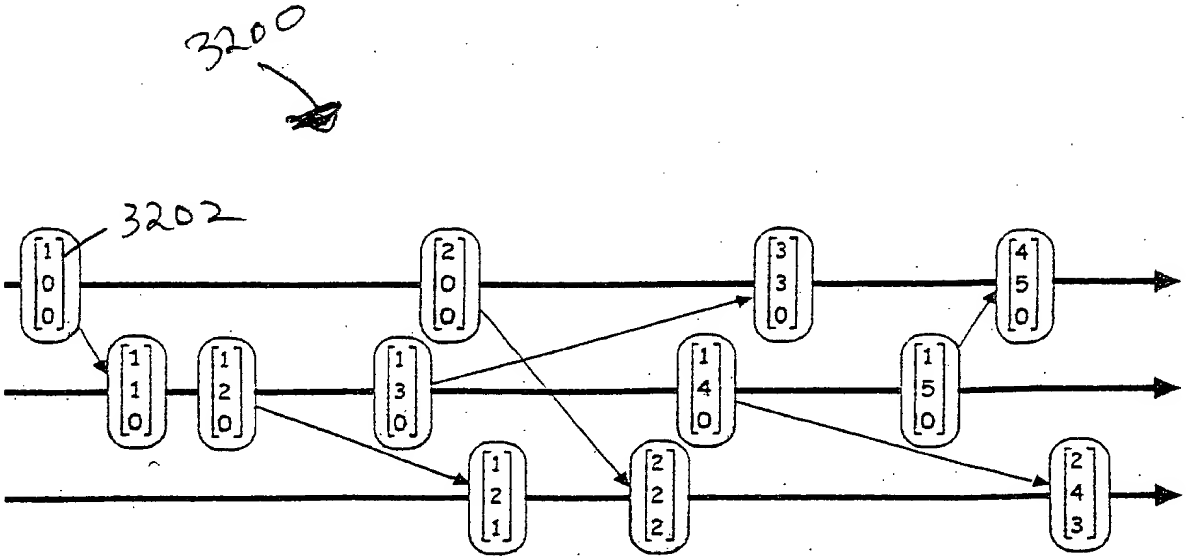


Figure 32

(prior art)

3300

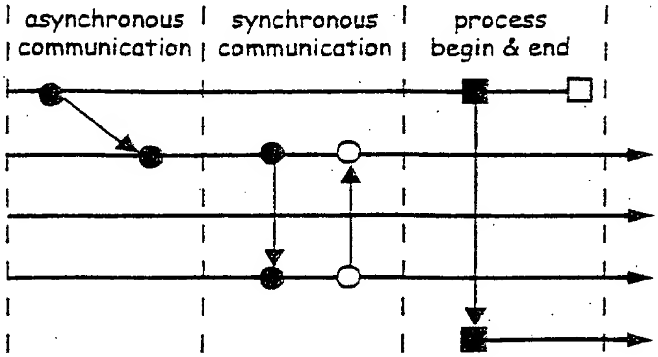


Figure 33

(prior art)

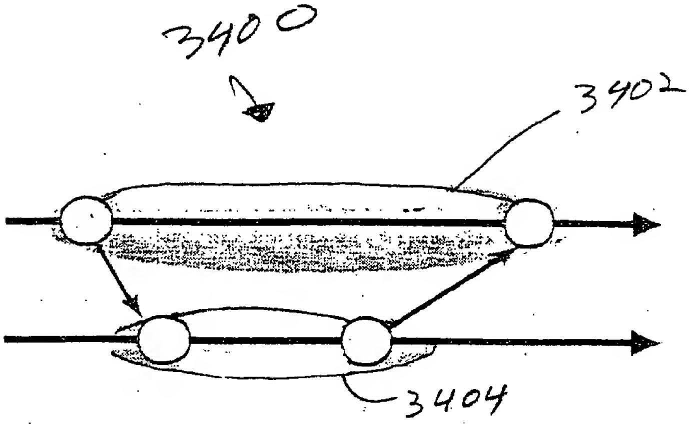


Figure 34

(prior art)

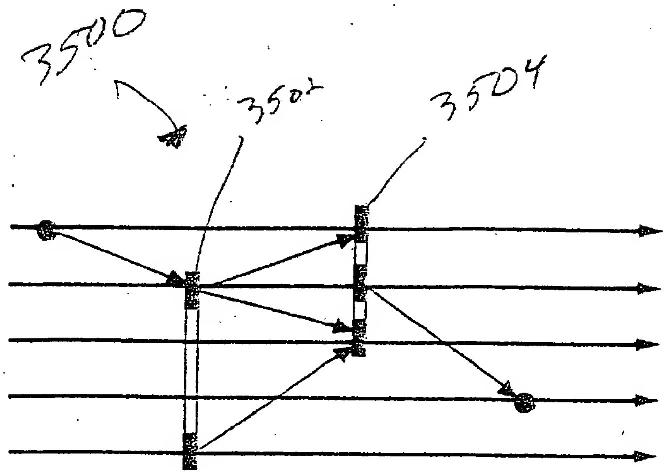


Figure 35

(prior art)

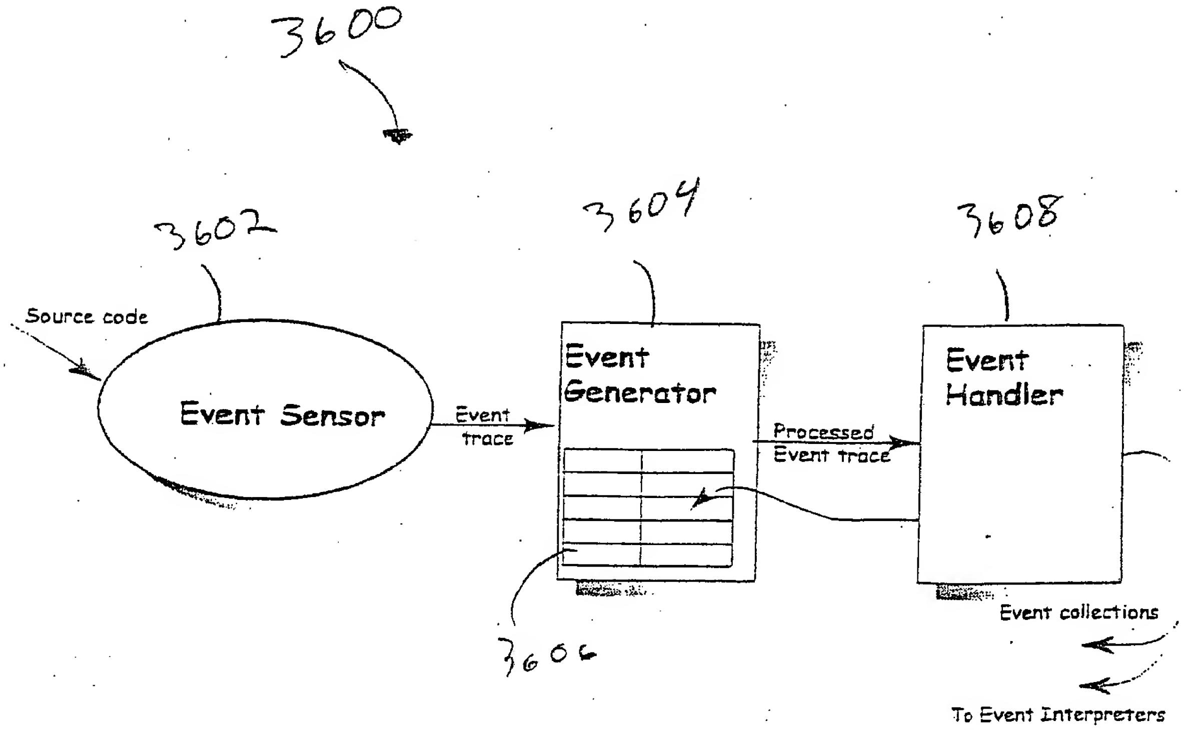


Figure 36

(prior art)

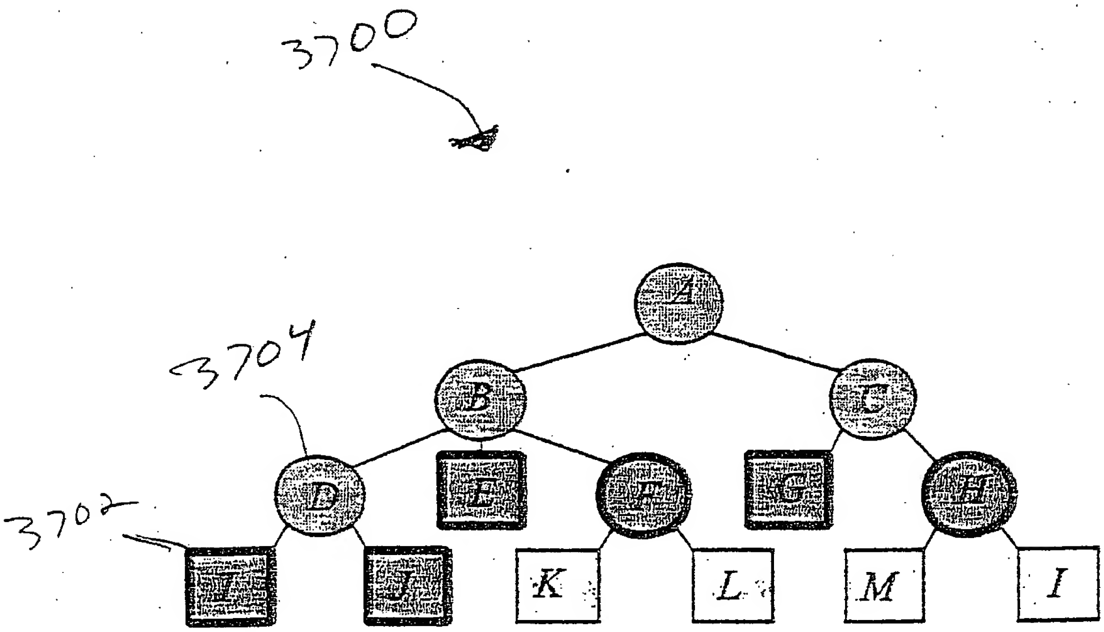
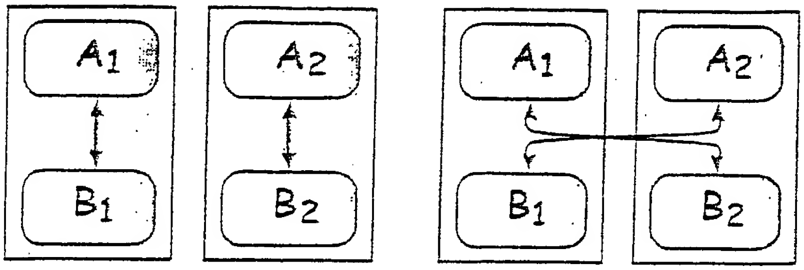


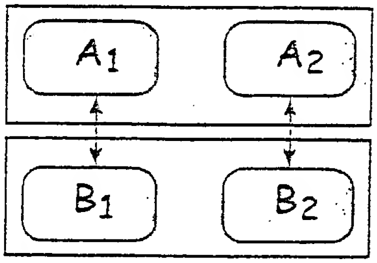
Figure 37

(prior art)



(a) Cohesion(P) = 1.0
Coupling(P) = 0.5

(b) Cohesion(P) = 0.0
Coupling(P) = 1.0



(c) Cohesion(P) = 1.0
Coupling(P) = 0.5

Figure 38

(prior art)

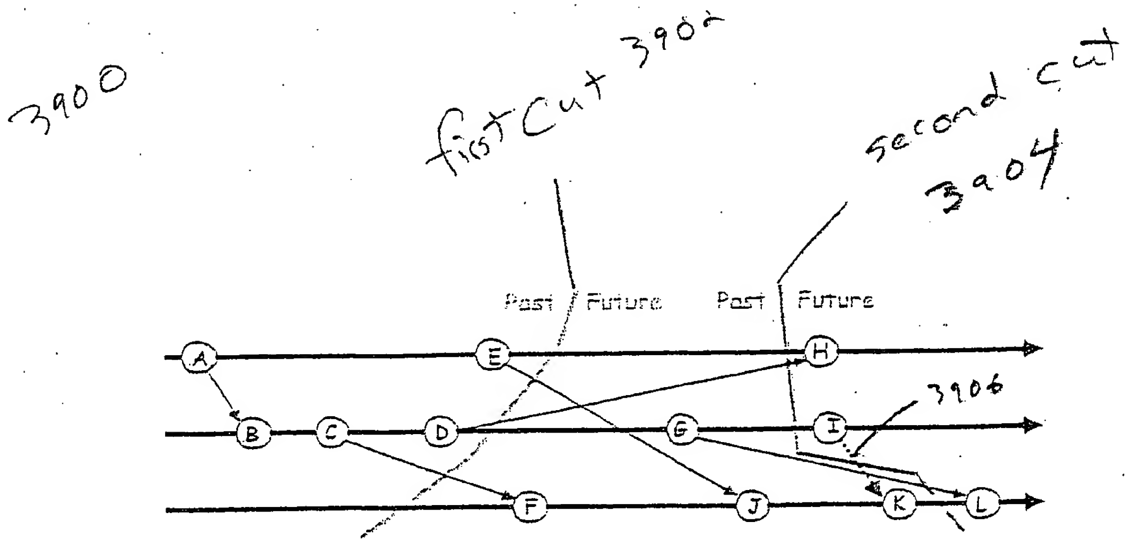


Figure 39

(prior art)

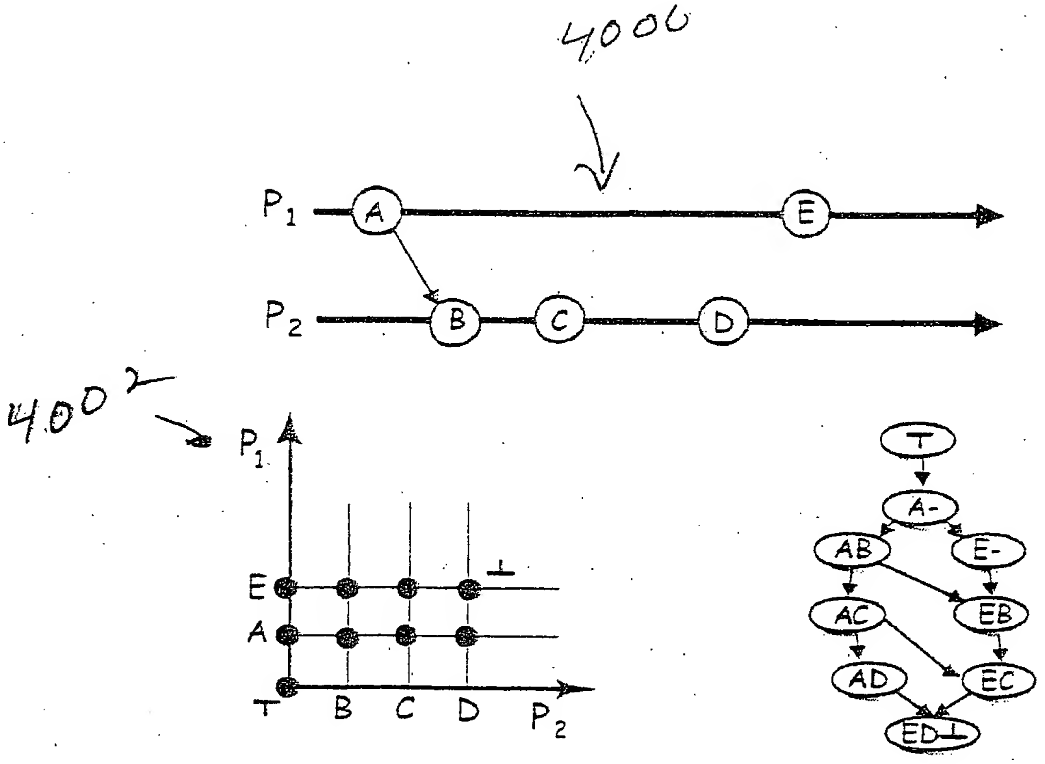


Figure 40

(prior art)

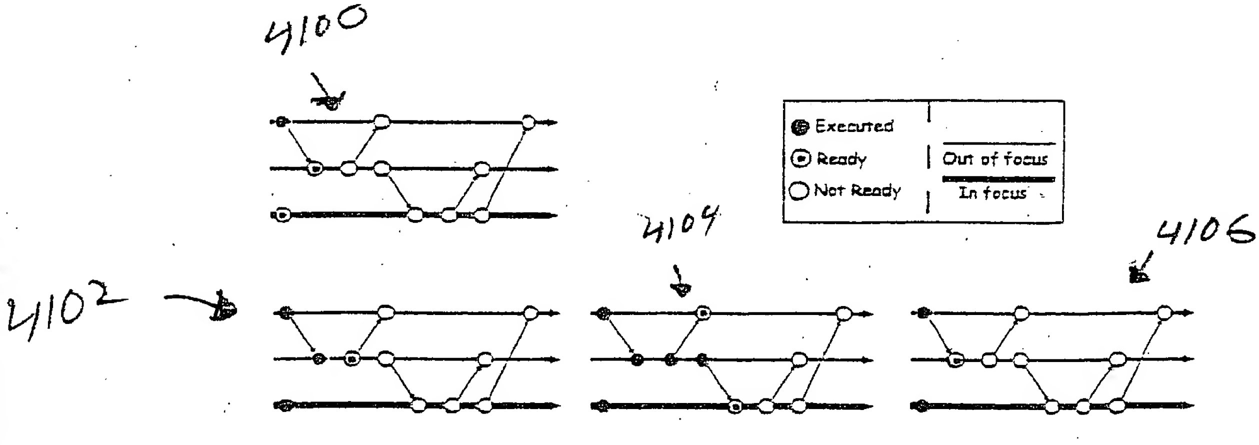


Figure 41

(prior art)

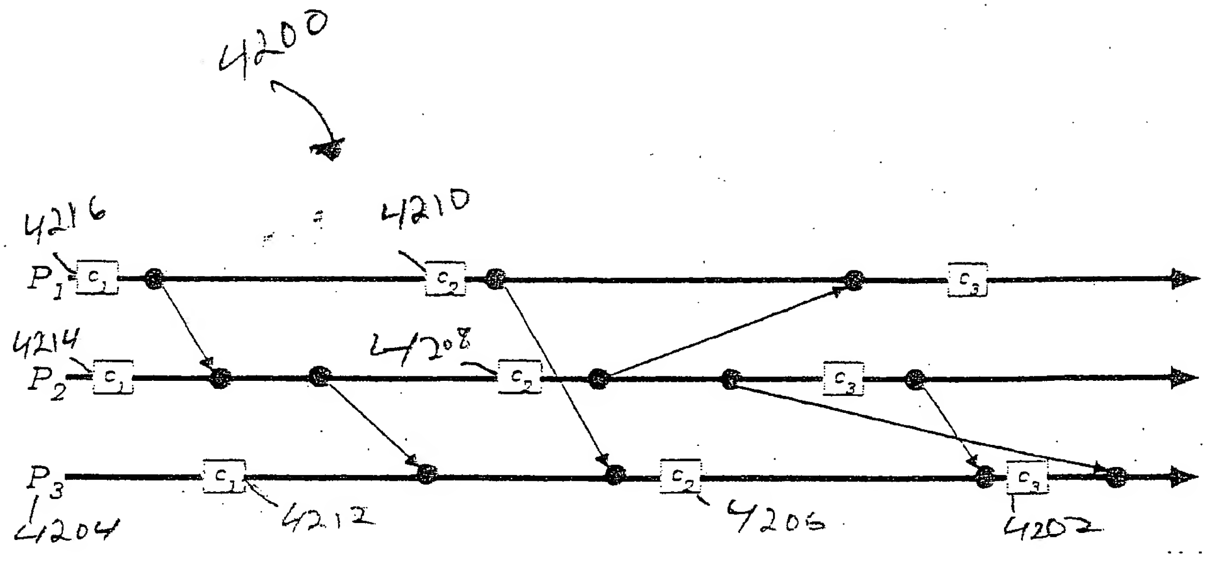


Figure 42

(prior art)

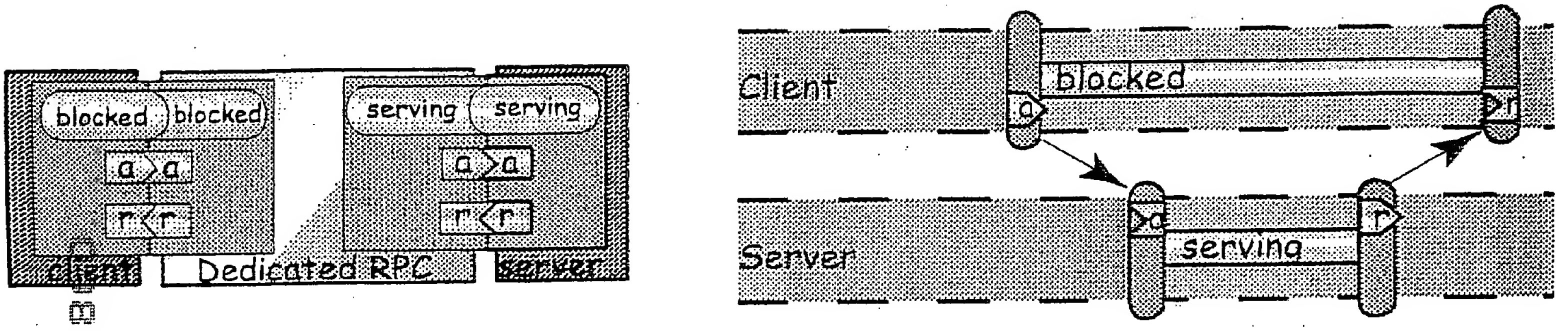

blocked
blocked
a
a
r
r
client
Dedicated RPC
serving
serving
a
a
r
r
server
Client
blocked
a
r
Server
a
serving
r

Figure 43

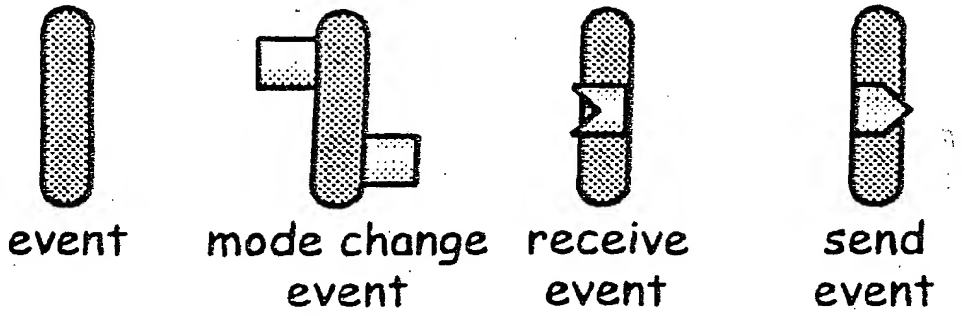


Figure 44

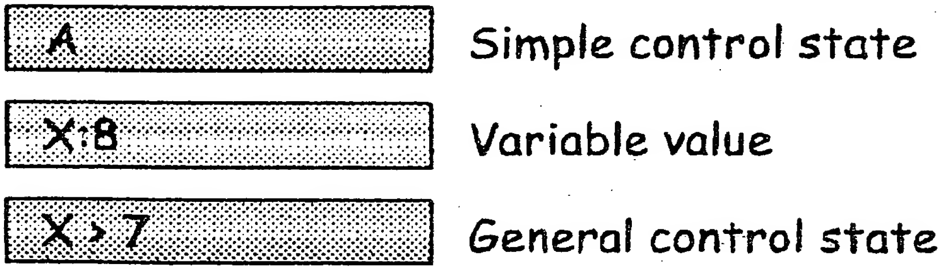


Figure 45

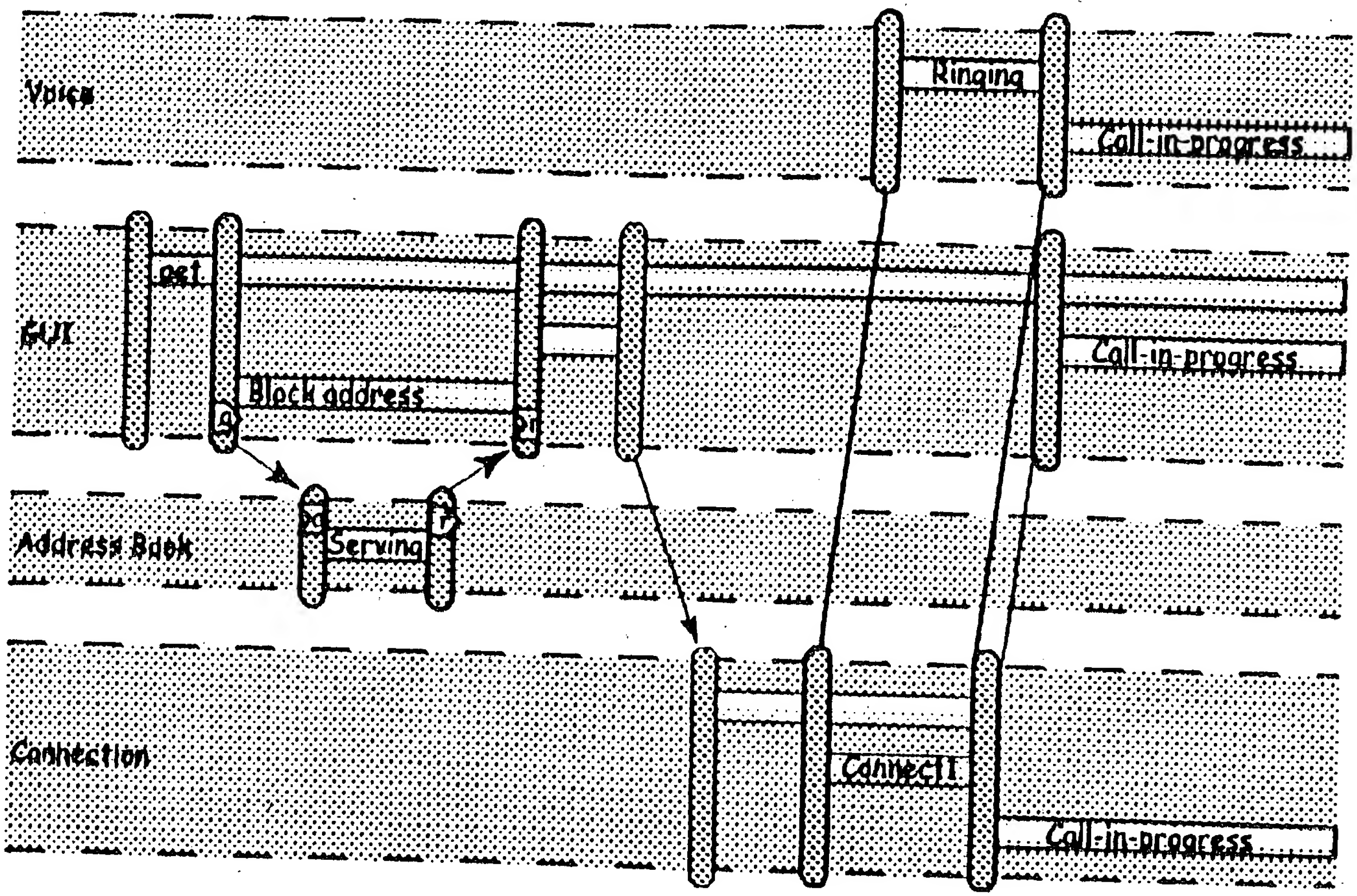

Voice
Ringing
Call-in-progress
GUI
get
Block address
a
r
Call-in-progress
Address Book
x
Serving
r
Connection
Connect1
Call-in-progress

Figure 46

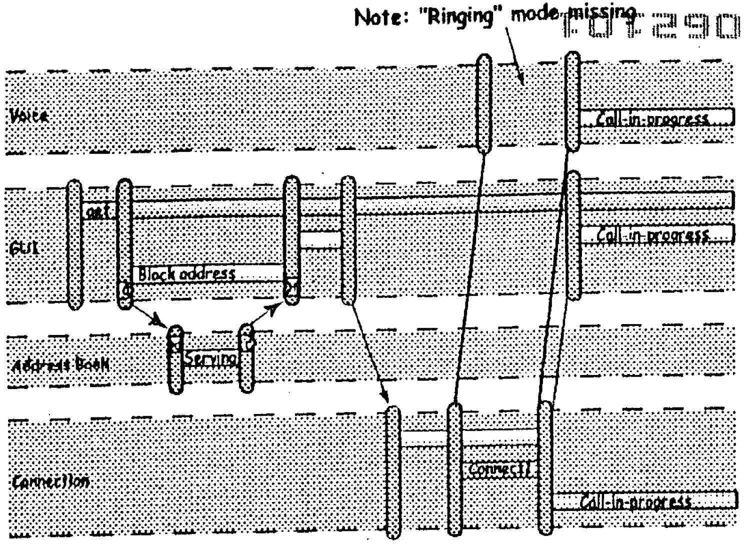


Figure 47A

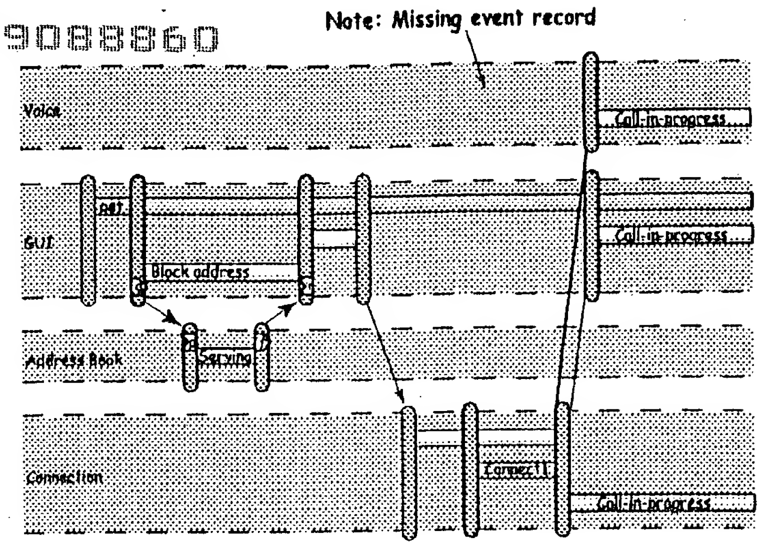


Figure 47B

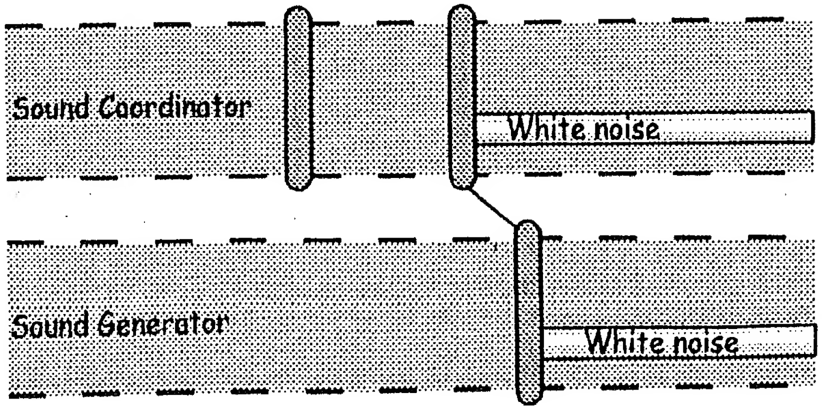
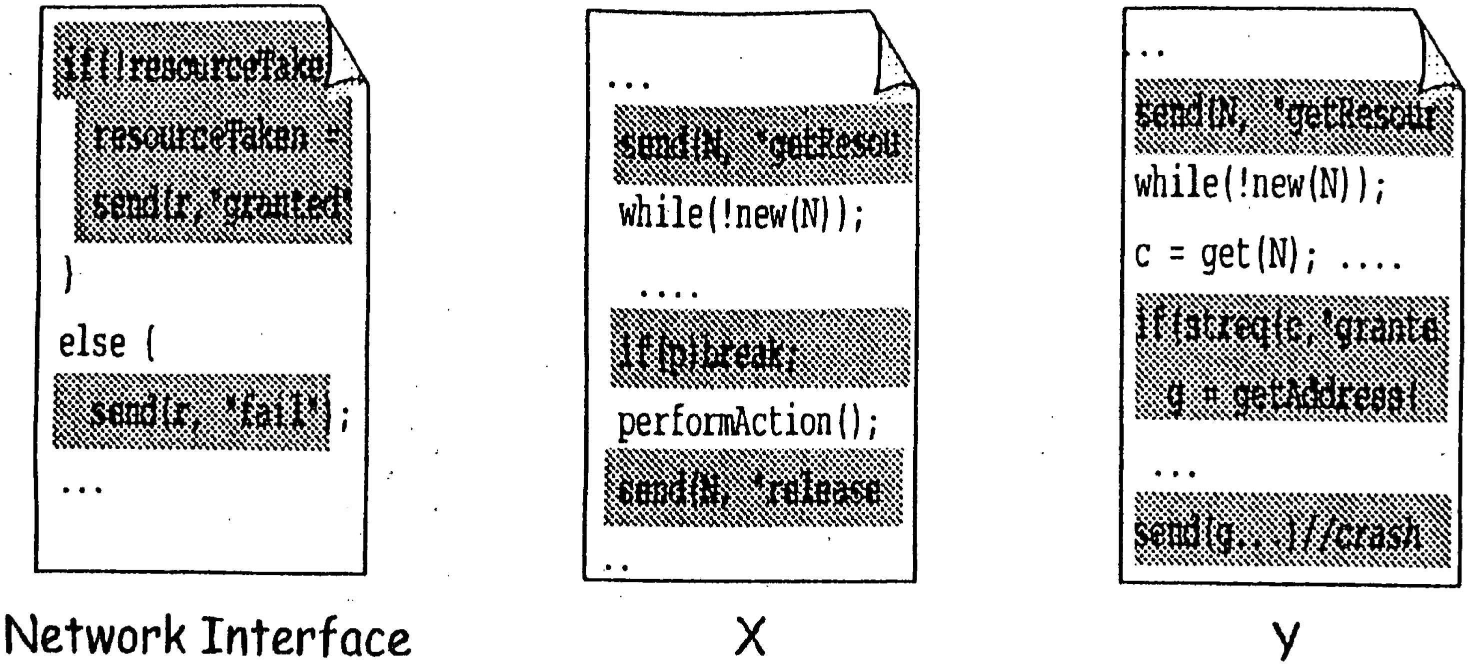


Figure 48



```
if(!resourceTake
  resourceTaken =
  send(r,"granted"
)
else (
  send(r, "fail");
...
```

```
...
send(N, "getResou
while(!new(N));
 ....
if(p)break;
performAction();
send(N, "release
..
```

```
..
send(N, 'getResour
while(!new(N));
c = get(N); ....
if(streq(c,'grante
   g = getAddress(
 ...
send(g,..)//crash
```

Figure 49

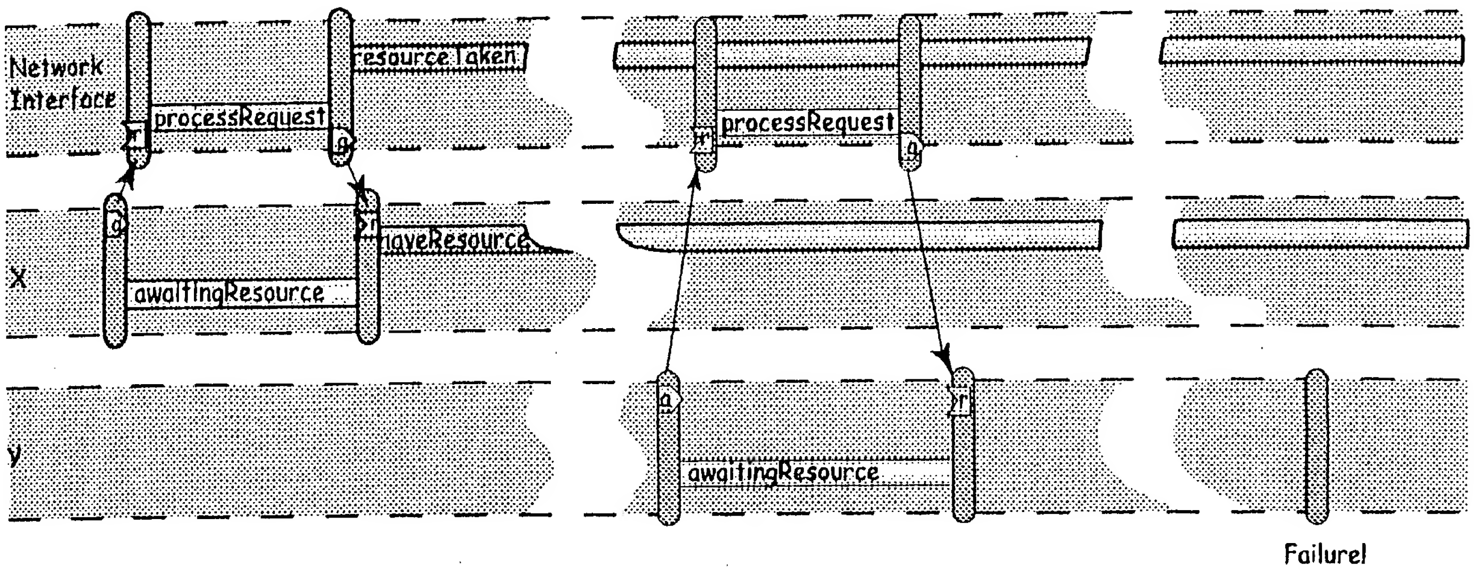

Network Interface
X
y
processRequest
resourceTaken
awaitingResource
haveResource
r
a
processRequest
r
a
a
awaitingResource
r
Failure!

Figure 50

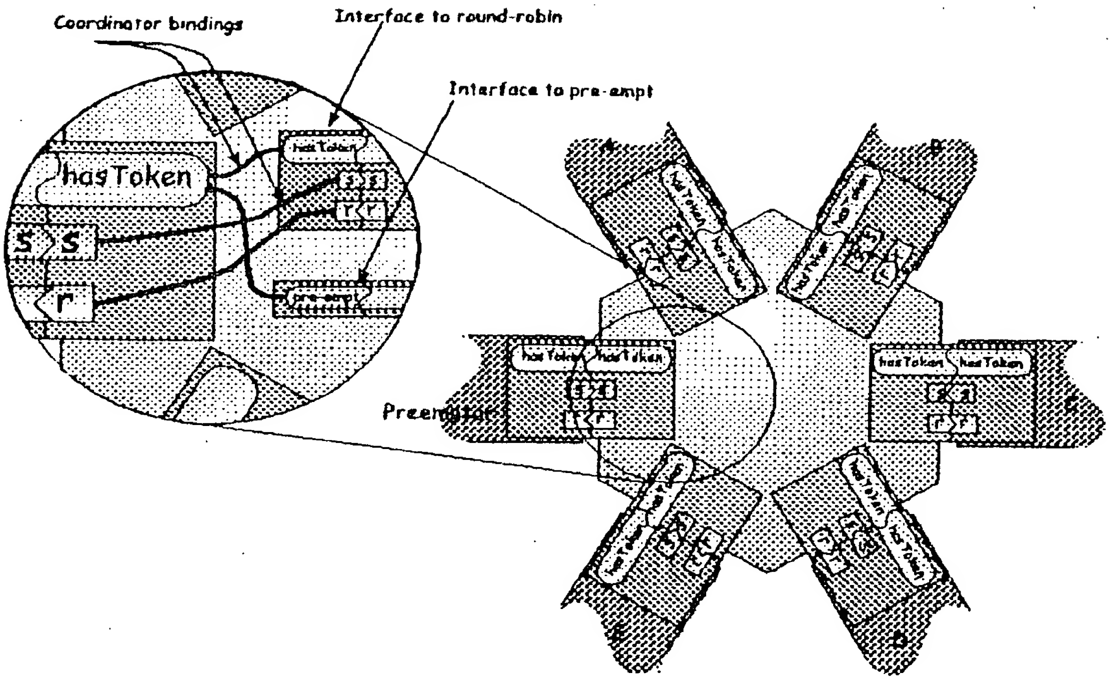

Coordinator bindings
Interface to round-robin
Interface to pre-empt
hasToken
s
s
r
r
pre-empt
Preemptor
hasToken
hasToken
A
B
C
D
E

Figure 51A

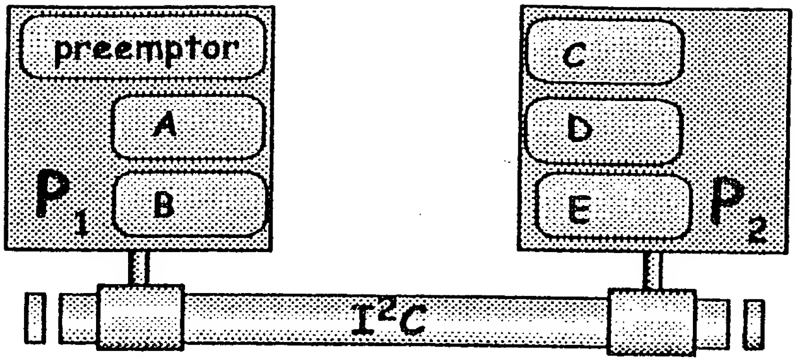


Figure 51B

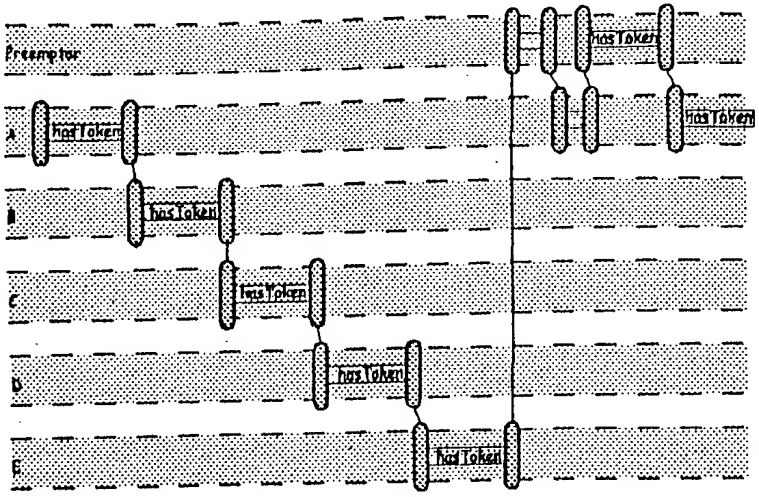


Figure 52A

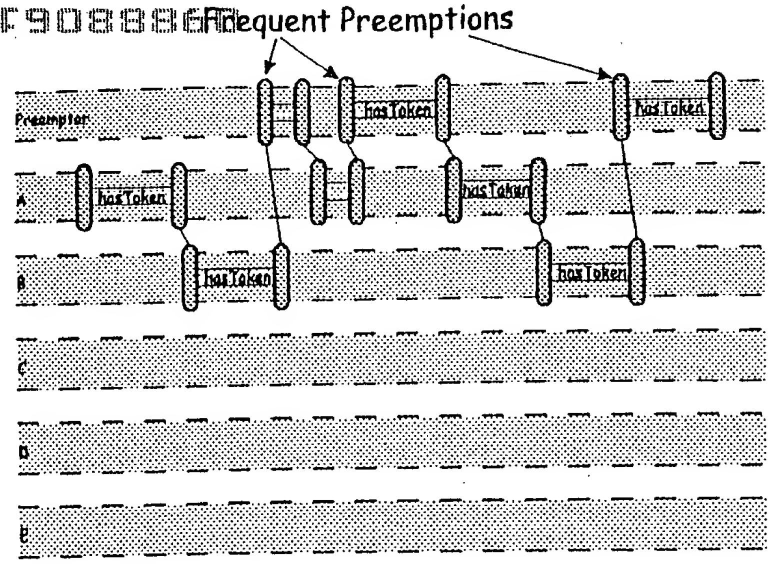


Figure 52B

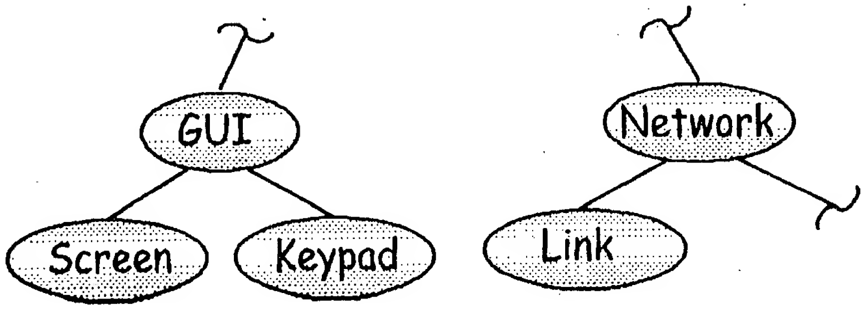


Figure 53A

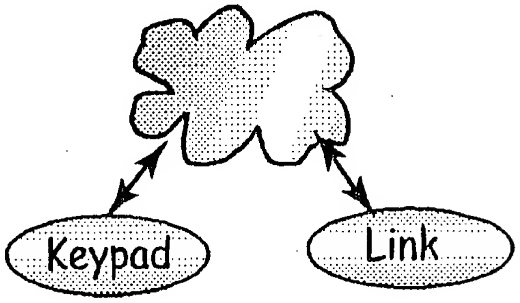
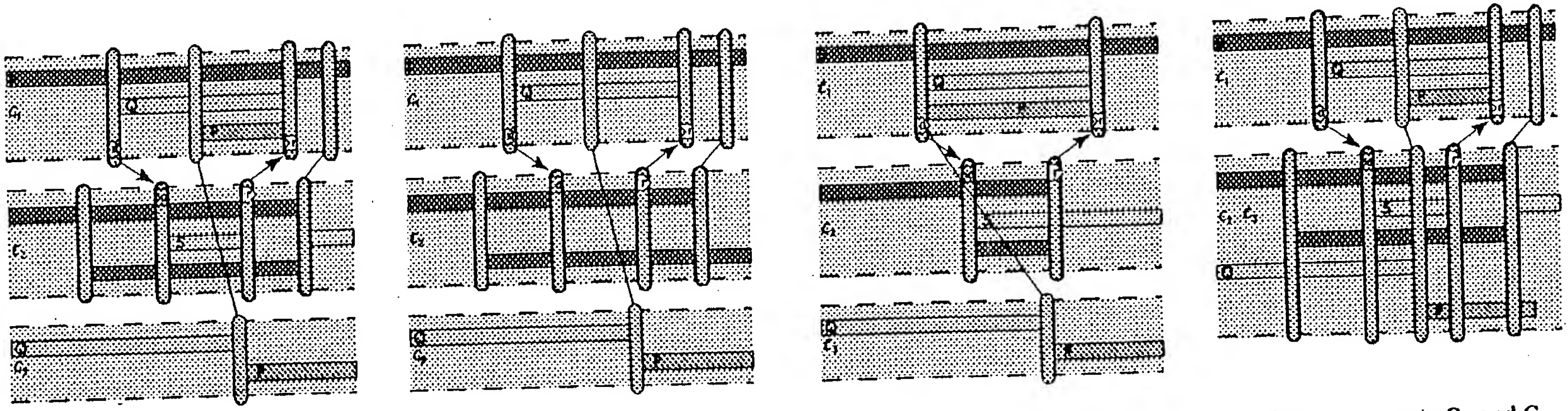


Figure 53B



(a) Complete evolution diagram.

(b) After states on C_2's middle and bottom trace are clustered.

(c) After some of C_1's events are clustered.

(d) After components C_2 and C_3 are clustered.

Figure 54

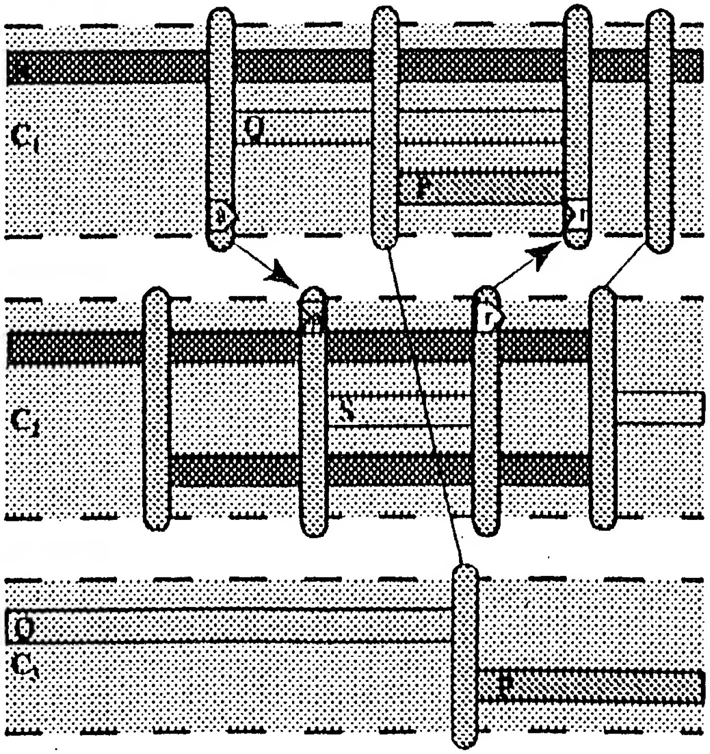


Figure 55A

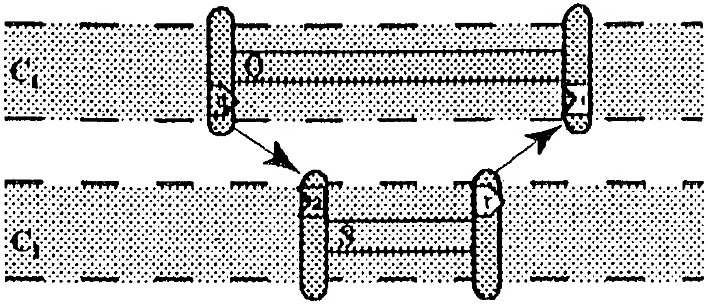


Figure 55B